AN EXPLANATION OF THE ORGAN STOPS

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WITH HINTS FOR

EFFECTIVE COMBINATIONS

BY

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TRANSLATED WITH THE AUTHOR'S PERMISSION

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DEDICATED BY THE AUTHOR

TO

PROFESSOR DR. H. VON HELMHOLTZ,

PRIVY-COUNCILLOR AT BERLIN.

PREFACE TO THE ENGLISH EDITION.

My paper on Organ Stops, originally written for a course of lectures to organists, was published by the desire of a committee of teachers. In altering and enlarging the original work for the press, I was struck by the number and excellence of literary works on the organ, its construction, preservation, and pitch. It is evident, however, that in these only a limited space could be devoted to the organ stops. During a practice of twenty-five years, interspersed with numerous concert-tours, and occasional calls upon me as an expert, I have made organ stops, their peculiarity and acoustic effects, my special study.

In working up this material, extending as it does over divers provinces of musical science, I secured the welcome co-operation of several highly experienced colleagues.

Before all others, I offer to Prof. Dr. A. Forster, of Berne, my warmest thanks for his kindness in stimulating and facilitating my studies by the loan of books on physical acoustics, and by highly interesting experiments. I also wish to offer my best thanks to the organ-builders who have thoroughly revised that portion of my work treating on the technicalities of organ-building.

The kind acceptance of the dedication of the following technical work by the great author of the "Sensations

of Tone," Prof. Dr. von Helmholtz, was specially encouraging to me.

I venture to hope that this modest work may find favour with all friends of the organ, even in its new English shape, and that it may serve to increase their number, and their interest in this the grandest of all instruments.

C. L.

Berne, Switzerland,
April, 1885.

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A.

Acoustic Tones. *See* Quint.

Acuta. *See* Sharp.

Æolina derives its name from the Æolian harp. (A charming description* of this ancient instrument is to be found in Radaus' "Lehre vom Schall.") It is of soft string-toned character, occurring in Germany and Switzerland on almost all large and small new organs as an 8-ft. solo stop. It is considered to be the most delicate of all stringed stops. The Æolina was originally a metal stop, but as the art of intonation in modern organ-building is capable of making the transition from wood to metal quite imperceptible, it is permissible to construct the lower notes of wood in this and some other stops. This stop is sometimes met with as an 8-ft. or 16-ft. reed (see Töpfer, "Orgelbaukunst," vol. i. § 180), either like the Physharmonica, or with a small bell. Walcker, for instance, has placed on his new cathedral organ at Riga a 16-ft. Æolicon (nearly related to the

* To obtain musical effects from the strings of an Æolian harp, you expose them to currents of air. This primitive instrument is made by glueing a thin sounding-board to an oblong wooden frame. From six to ten catgut strings, tuned in unison, are then stretched over two bridges fixed on the short ends of the frame. Placed in an open window or in an aperture of a tower, obliquely to the current of air, the Wind- or Æolian harp will give out the most beautiful harmonious sounds.

Æolina), as a reed on the second manual, and the above described 8-ft. Æolina as a flue on the fourth manual. T. F. Witte, of Utrecht, has also arranged a very successful 16-ft. Æolina as reed stop on the third manual of the new organ at the Hague, Holland. Æolina combines well with Voix Céleste (*q.v.*), which is tuned slightly sharper, as well as with Wienerflöte and Lieblich-Gedackt. This latter combination may be improved by introducing the brighter character of the Flauto Traverso or Flûte d'Amour. (*See* Combinations of Stops.) For the physical generation of tone in flues, *see* Flue Stops.

Amoroso. *See* Flûte d'Amour.

Arrangement, or **Disposition,** from the Latin *disponere,* to dispose, implying arrangement (also proper subdivision), is briefly the plan and arrangement of the whole plant of an organ, according to its size, power, disposition of stops, and material. The whole success of this work of art depends upon the carefully considered "arrangement," which should be in accordance with all the rules of acoustics, and adapted to the proportions of the building destined to receive the organ.

B.

Baritone. *See* Tuba Mirabilis.

Bassethorn. *See* Serpent.

Bass Flute, or **Flute Bass.** *See* Flute.

Basson is more particularly a *French* striking reed, with so-called anches à larmes, similar in intonation to a soft trumpet. It occurs as a 16-ft. stop on the first manual of Walcker's organ at Glarus. According to Faisst, Basson

coincides with the French name for the Bassoon, both as orchestral instrument and as organ stop.

Bassoon is a small scale stop, usually constructed as a free reed, which occurs, if of 16-ft. tone, on the manuals as well as on the pedals (frequently labelled Double Bassoon). If of 8-ft. tone, this stop occurs only in the two lower octaves, Clarionet and Oboe succeeding it in the higher octaves. (*See also* Dulcian.)

Bells. *See* Carillon.

Bifara, Tibia bifaris. *See* Double Flute.

Blower's Signal. A draw stop applied to many organs, serving to call the blower's attention to the bellows. I may here mention that I have now and then seen people engaged as blowers, who, being the reverse of intelligent, had for that reason been chosen for this apparently inferior post. Through their violent pulling, sudden releasing, and generally incompetent treatment of the blowing apparatus, great expense has been incurred, which would have paid a thoroughly trained, conscientious blower for years. At the present date water and gas engines are frequently used for this purpose with large organs, an arrangement which offers many advantages to the organist, particularly for practising purposes at odd moments, as it makes him independent of the blower (Calcant).

Bombard appears as a 16-ft. and 32-ft. striking reed on the pedals. With regard to power it stands between Trombone and Bassoon. (*See* Trombone.) It is seldom found on the manuals. There are, however, organs in France, on which the third and fourth manuals form together a so-called Bombard-manual based on the 16-ft. tone; for instance, St. Sulpice, St. Eustache, the Madeleine, and St. Denis (see Töpfer, vol. i. § 1265). Like the Trombone, the

Bombard requires correspondingly powerful reeds as a covering. (*See* Reed Stops for the physical generation of tone in reed pipes.)

Bordun. *See* Bourdon.

Bourdon. A covered wood stop, never wanting even on the oldest organs, and which, by its massive full sound, is able to lend to the manual extreme dignity and an ecclesiastical solemnity of tone. The usefulness of this stop (also as a solo of 8-ft. tone, particularly in the upper registers), if well intonated, has latterly been more and more fully recognized. (*See also* Rohrflöte.) A 16-ft. Bourdon on the manuals, if neither size nor material have been spared, gives depth and fullness even to the smallest organ. (*See* Double-stopped Bass for the application of a 32-ft. Contra-Bourdon to manuals and pedals (by William Hill, of London).) The Bourdon stops are subdivided into Bourdon, Gedackt, and Lieblich-Gedackt, and are sized in this order. In England the 16-ft. Bourdon often stands for 16-ft. Sub-Bass. (*See* Gedackt.) Bourdon is a stop available for any combination. I found it had a peculiarly beautiful effect in conjunction with a soft, well-tuned Trumpet, or if coupled to a well-tuned solo reed on one of the upper manuals. Bourdon, in fact, has the special quality which enables it to be combined most conveniently with any other stop; hence the old name of Coupling-Flute, or, more shortly, Coupler. (*See also* Combinations of Stops.)

Bourdonecho. *See* Echo.

C.

Carillon (Bells) is an arrangement now and then met with in large organs. I found it surprisingly effective for secular music, as for instance in the new concert organ of the Trocadero Palace, Paris. In the organ of Merseburg Cathedral (C. F. Becker), there is a Carillon from C to C‴, composed of thirty-seven polished steel rods. For church Carillons, principally found in Dutch churches, I refer the reader to Radaus' "Lehre vom Schall," p. 272. One example of these is found in Amsterdam, comprising forty-two bells, with a compass of three and a half octaves. On several occasions I found, on Italian organs, Carillon as a special stop, beginning with c′. In the large organ being built by Hill and Son for Sydney, there is a Carillon of four ranks on the Echo Organ; and in Witte's organ at the Hague there is one on the third manual.

Celestina. *See* Voix Céleste.

Chalumeau. *See* Schalmei.

Clairon (small trumpet), sometimes labelled Clarino or Clarion, is a reed of rather narrower scale than the Trumpet, and with a brighter sound; it chiefly occurs as a 4-ft. (more rarely 2-ft.) pedal stop. For particulars, *see* Trumpet.

Claribella (**Clarabella**), from the Latin *clarus*, bright, and the English *bell*, meaning therefore "the bright sounding (voice)," is an 8-ft. and 4-ft. flue pipe, similar to our open 8-ft. Flute, pleasantly refreshing in character; occurring frequently in large new English and American organs (Liverpool, Canterbury, Birmingham, Garden City U.S.A. and others).

Clarionet. An 8-ft. tone, intended to imitate the orchestral instrument of the same name. It is of small scale, cylinder shape, and has conical bells (resonant tubes). With regard to power it stands between, say, a softly intonated Trumpet and an Oboe. It is a solo stop of brilliant effect. Clarionet is one of the few reed stops which in Germany and Switzerland are constructed almost exclusively as free reeds. (*See* Physharmonica.) In England and France this stop occurs as a striking reed. In Switzerland very nice Clarionets are found even on small organs. As a rarity Clarionet occurs as a pedal stop of 4-ft. tone in Silbermann's Court organ at Dresden. It combines well with 8-ft. Bourdon, and, if necessary, by the aid of couplers, with Concert-or Wiener-flöte and 4-ft. Flauto Traverso, or 4-ft. Flûte d'Amour.

Clavæolina. *See* Æolina.

Combinations of Stops. It is clear that the limited space of this modest and concise work does not permit of our enlarging upon the theory of stops; nor is it possible to give a reprint of the many and varied arrangements. Where occasion offered I have endeavoured, however, to give a few useful hints for good combinations at the end of articles on certain stops. They naturally make no claim to completeness, and must be modified in each case in accordance with the intonation of the organ in question. As the results of a varied experience, they will, I trust, be of service now and again to brother organists, by giving an outline of the relative proportions of stops in combination. From my various propositions a tolerably skilful organist will easily recognize my endeavour to point to the relations and affinities of stops, which must be strictly observed, as they are entirely distinct, according to their foundation

tone. In Flautino and Flageolet, for example, the necessity for an appropriate covering, and the quality thereof, is pointed out; in Bombard and Trombone the proportionate power of the flue stops is to be considered; in Mixture, Sharp, Cymbal, etc., their exclusive employment on the Great Organ is expressly demanded. In the paragraphs on Flues, Mixtures, Reeds, and others, some rules are laid down for correct combinations to suit the express occasion. For instance, solemnity, dignity, and volume are obtained by means of the round, noble tone of the Principal, together with the Gedackts, Flutes, and Gambas; brilliancy and acuteness by means of mixtures, 2-ft. flues and piercing reeds. The organist must first make himself acquainted with the 8-ft. tone on his organ, which is the basis of all stops; the Tremulant is often abused even to vulgarity, and the predilection for sudden transition from the Great Organ to a solo without due preparation, easily becomes mere craving for effect. A well-considered, appropriate choice of stops, suitable to the character of the voluntary and hymn, and a noble simplicity, free from all exaggeration, are the chief qualifications for the performance of a dignified church service. An important requisite for fine organ-playing is a careful choice of the number and combination of stops proportionate to the size and acoustic properties of the building, and in keeping with the sacredness of the place. To this end the advice of a real master in organ-building, and of an experienced and clever organist, is absolutely indispensable. The Composition Stops (now found on nearly all new organs), by means of which the organist can draw three, four, or more combinations without further reflection, make matters much easier for the beginner, and even perhaps tend to make him indolent.

Hints for combinations can naturally only be given and received on a broad basis, as every church, every organ, and every work of art whatsoever has peculiarities of its own, resulting from different causes. Music Director R. Löw, organist at Bâle, writes me the following excellent letter on this subject:—"In the church of St. Elizabeth I can combine much that is beautifully effective, while in the Münster the same combinations give a totally different result, and *vice versâ*. Every organ requires studying, and although certain rules for the use of stops must always remain law, still the minor details cannot be specified; and let a number of stops appear ever so heterogeneous at the first glance, they will under certain acoustic conditions combine well."

Furthermore the celebrated Berlin organist, Otto Dienel, gives me the following concise practical rules on the use of stops, for insertion in this book, and on which alone one might write a good-sized paper. "According to the tone-character of the organ stops, the following combinations can be formed: 1. Principal character; 2. Flute and Gedackt character; 3. Gamba or Salicional character (strings); 4. Reed character; 5. F or FF character as produced by the Mixtures. Compound combinations of the above groups of stops are not only possible but exceedingly effective. In choosing stops one must remember that the 4-ft., 2-ft., $2\frac{2}{3}$-ft., and mixture stops only strengthen the small number of harmonics of the 8-ft. foundation tone, and that the 16-ft. manual stops only assist the combinational tone, which is composed of two sound-waves of the 8-ft. tone. It therefore follows that the foundation tone must be represented before all others, and that the remaining voices must only be employed to give a colouring."

Indispensable hints for obtaining tasteful combinations are also found in the article on Tone Colour. Here must be also mentioned the gradations of the strings, flutes, gedackts, reeds, mixtures, etc., according to power, the study of which—the comparing and impressing of them upon the mind—I cannot recommend too highly to young organists.

In conclusion, I cannot help giving a few passages on ecclesiastical organ-playing from Anthe's "Music in Relation to the Protestant Rite." He expresses himself with charming fitness: "It is the sublime object of religious music, and therefore particularly that of the organ, to lift the soul towards the Almighty by the marvels of sound. Greatness and sublimity are its inviolable laws. All parts of church organ-music must form an harmonious whole, only intended to serve the purpose of Christian edification. Secular airs and variations here appear as a profanation of the sanctuary. 'Put off thy shoes from off thy feet, for the place whereon thou standest is holy ground,' would be a suitable inscription on every organ;" and no matter, I would add, whether it stands in a Protestant or a Catholic church.

Combination Stops (constructed either as pedals, draw stops, or combination pistons) call into action certain groups of stops, previously connected for this purpose. They affect either separate manuals or the whole organ. The organ of the Royal Albert Hall, London, has no less than thirty-two combination buttons for four manuals, and a number of pedals acting upon combinations affecting the whole organ. The giant organ (126 stops) being built by Hill and Son (s/ Trombone) for Sydney, presents a most astounding variety of couplers, composition, and combination stops.

Composition Coupler. A pedal, or stop, which pushes out all the couplers at once.

Composition Stops (from the Latin *componere,* to place together) are contrivances (pedals, draw stops, or pistons) which bring into action the whole of the stops on a manual, or a certain prearranged set of stops. In the church of St. Eustache, Paris, there is, for instance, one draw stop labelled Fonds, and one Anches, which embrace respectively all the corresponding groups of foundation stops and reed stops.

Composition Swell Pedal. *See* Crescendo.

Concert-Flute. Similar to the rather brighter sounding Wienerflöte, *q.v.*

Contra-Bass. *See* Double Bass.

Contra-Bourdon. *See* Double-stopped Bass.

Contra-Trombone. *See* Trombone.

Contra-Violon. *See* Double Bass.

Cor Anglais. *See* English Horn.

Cormorne (also called **Cromorne, Cremorne, Krummhorn**) has a soft-sounding horn tone, and is met with in many old organs as an 8-ft. reed stop.

Cornet belongs to the mixture stops. It is based upon the natural scale, and, if 5-ranked, is composed of C, c, g, c′, e′, having pipes of 8-ft., 4-ft., $2\frac{2}{3}$-ft., 2-ft., and $1\frac{3}{5}$-ft. tone. The 4-rank and 3-rank stops are smaller accordingly. Occasionally one meets with a Cornet based on a 16-ft. rank, as in the church of St. John, Schaffhausen, and in the Music Hall, Boston. The Cornet is only a good one if all the notes or the tones of a chorus blend in such a manner as to leave no single tone perceptible (see Töpfer, "Orgelbaukunst," part i. p. 97). The scale of the Cornet is comparatively the widest employed in the organ, and, on account

of its numerous chorus of pipes, is the only mixture stop which does not repeat; whilst the mixture proper often repeats the notes of the higher octaves at the pitch of the previous octave (*see* Mixture). The effect of a well-arranged Cornet is that of great volume; its intonation is loud, and its tone resembles the horn, from which it derives its name (from the Latin *cornu*, the horn).

Cornet is one of the few mixture stops which can be employed as a brilliant solo, naturally only in combination with foundation flue stops of equal length of tone.

Corno. *See* Cornopean.

Corno di Bassetto. *See* Ophicleide.

Cornopean (from the Latin *cornu*, horn, and the English *pean*, pæan, hymn of praise) is an 8-ft. flue stop of horn-like tone. In new English and American organs it is frequently placed in the Swell Box, by the side of Cornet and Oboe. In the new Votiv organ at Vienna, Walcker has also a 4-ft. Corno, as striking reed; and Hill and Son have placed an 8-ft. Cornopean in Westminster Abbey and in the large organ for Sydney.

Couplers. The well-known contrivance for combining the various manuals with each other, and the manuals with the pedals. I may here say that I consider it advantageous in small organs for coupling not only the first manual, but also the second manual to the pedals, as the latter arrangement permits a clever organ-player to accompany discreetly, yet most accurately, a soft solo on the first manual by the Sub-Bass, which in turn is delicately supported by a stop on the second manual. I should here mention the Swell Bass, obtained by coupling with the lowest octave of a 16-ft. Lieblich-Gedackt. By means of combinations, possible through coupling manuals to pedals, an astonishing

variety of the most beautiful effects is obtainable, and I agree with Domcapellmeister Greulich, of Breslau, in most warmly recommending beginners to study all the variations and shades of tone that can possibly be produced on their organ. (*See* Combinations of Stops.)

Coupler is (2) the antiquated name for an actual stop, and an abbreviation of the word Coupling-Flute, so named on account of its fitness for blending with every other voice. It is usually stopped, and occurs as 16-ft., 8-ft., and 4-ft. tone. The name Coupler for an actual stop is now obsolete, having been very rightly superseded by Bourdon, or Gedackt. (*See* Bourdon.)

Coupling. *See* Couplers.

Crescendo is the well-known pedal (usually placed low on the right-hand side) by means of which the shutters of the Swell are opened and closed. As a rule, the pipes of one manual only are placed in the Swell. This is a disadvantage in German and Swiss Swell Organs, as compared with the English and French ones, that they often have only a comparatively weak, even feeble, manual—on which there is practically nothing to increase or diminish—inside their Swell Box. I therefore mention the fact—so strongly dwelt upon by Otto Dienel in his lectures to the Society of Organists in Berlin—that the English, in particular, generally have more and louder pipes on the Swell than on the Great Organ, by which means they produce correspondingly brilliant effects in light and shade.

But to return to German instruments. The organ of the Vienna Musikverein (by Ladegast) has a pneumatic (*see* Pneumatic Action and Pneumatic Combination Pistons) Crescendo and Decrescendo, adjustable to any degree of power for the whole system of couplers, as well as for each

individual manual and pedal, with an Indicator and an Echo. (Compare the arrangement of the St. Peter's organ at St. Petersburg.)

Another kind of Crescendo, called Composition- or Pedal-Swell (also Roller Swell), rarely met with owing to its complicated mechanism, is found, amongst other places, in the cathedral of Ulm and the convent church at Engelberg. By means of a roller worked by the foot, all the stops, one by one, from Æolina up to Great Organ, can be brought into play, and thrust in again for the Decrescendo by a backward rotation of the roller. If the stops follow and join in happily chosen succession, if the transition to the tone of the mixtures is cleverly graduated, and if, lastly, the mechanical part of the arrangement is perfect, this kind of roller swell is of exceptional advantage to every larger organ. The most perfect system for a Crescendo on the whole organ is that of the pneumatic action, by means of two power-bellows, one of which works the Crescendo, the other the Decrescendo. The organist need only couple the roller to the pneumatic action by a movement of the foot, and the apparatus is at once set in motion. The backward action is started by a special draw stop. By means of a lever, both Crescendo and Decrescendo can be at once disengaged. The contrivance suggested by Dr. Faisst, and already employed in several larger organs (for example, in the church of St. John am Feuersee, Stuttgart), is a very welcome one. An Indicator is connected with the Crescendo in such a manner that, according to the pressure on the pedal key, the movable disc indicates the number of stops brought into action; so that in every position of the pedal key the organist may know at once what power of tone he commands at the moment.

Cymbal is a mixture stop of narrow scale, which, on account of its small pipes, is the acutest of all the mixtures; it is consequently the last stop to be drawn for the Great Organ. It occurs as a 4-rank Cymbal on the new Sydney organ (126 stops).

D.

Diapason. This name denotes not only a tuning-fork, but in organ-building applies also to the stops, Principal, Octave, and Gedackt; but chiefly in English organs, where (for example, Westminster Abbey and Town Hall, Sydney, etc.) it frequently occurs on all four manuals as principal bass, under the name of 16-ft. Diapason, 8-ft. Open Diapason, 8-ft. Stopped Diapason, and on the pedals as 32-ft. Open Diapason (the 4-ft. Octave so important for the temperament [*q.v.*] is labelled 4-ft. Principal). (*See also* Principal and Octave.) Seidel, in his work, adopts the term Disdiapason for the Super-Octave. Violin-Diapason is a name for the 8-ft. Geigenprincipal on nearly every English and American organ.

Differential Tones. *See* Quint.

Dolce, an 8-ft. string-toned metal stop, similar to Salicional, is an extremely mellow solo stop, wider in scale than Salicional, and constructed by some builders as a cone (a little wider at the top). In Westminster Abbey it appears as 4-ft. Dulcet. In large organs it ought to be placed more frequently on the Great manual, to which, as a soft string-toned stop, it would lend more power of expression than the naturally powerfully intonated Gamba can give. By some builders (Weigle, for instance) it is

voiced soft and flute-like, viz. in no wise string-toned, like Flauto Dolce. (*See* Æolina for the use of wood in the construction of the lowest notes.) It combines well with 8-ft. Bourdon, 8-ft. Hohlflöte, 4-ft. Flûte d'Amour, and, if coupled, with Zartflöte or Wienerflöte 8-ft. (*See* Intonation.)

Double Bass (Contra-Bass). As 32-ft. stop it is acoustically combined with 16-ft. Violin and $10\frac{2}{3}$ Gedackt (that is to say, $5\frac{1}{3}$-ft. long, but producing $10\frac{2}{3}$-ft. tone, *vide* Gedackt). As an open 32-ft. and 16-ft. pipe, it is always intonated—as far as string character and power are concerned—between the Violin Bass and Principal Bass (Open Diapason Bass), which latter stop, especially on French organs, it is often called upon to replace. A very successful 16-ft. Double Bass is equivalent to the orchestral instrument of the same name; and Bergner, organist at the cathedral, Riga, writes me word that his Contra-Violin, for instance, is of enchanting beauty. (*See also* Sub-Bass and Double-stopped Bass.) Steinmeyer, organ-builder at Oettingen, has, probably on the basis of the above-mentioned intonation, placed a 32-ft. Contra-Violon in Rothenburg an der Tauber, and in the Frauenkirche, Munich; and a difference, even for a musically trained ear, can only be found in the greater power of certain harmonics.

Double Flute. An open wood pipe, usually of 8-ft. tone, furnished with double, that is to say, two diametrically opposed lips, and also with double slits. It therefore has a brighter sound than the single-lipped Flute. English organ-builders usually place it on the Solo Organ, as has been done on the Town Hall organ, Sydney. It also occurs under the name of Duiflöte and Jubal Flute (*q.v.*). It is of enlivening effect in combination with an 8-ft. Gamba. A double-lipped 16-ft. Flute Bass is placed on the second

pedal (*see* Hohlflöte) of the Marienkirche, Lübeck, and a double-lipped Rohrflöte (*q.v.*) on the cathedral organ of Breslau. Under the name of Bifara, Walcker has arranged (for St. Petersburg) a 2-rank Double Flute; the first rank has stopped 8-ft. pipes, the second rank, Dolce, open 4-ft. pipes.

Double-stopped Bass (**Untersatz, Majorbass**) frequently occurs as a 32-ft. stopped pipe on the pedals. If space and means are limited, this stop often has to take the place of an open 32-ft. pipe. (*See* Sub-Bass and Double Bass.) In the large organs of Russian Libau, Riga, Paris, London, Leipsic, Ulm, Sydney, and a few others, it is often labelled 32-ft. Contra- or Grand- Bourdon.

Doublette is usually called by the French builders the 2-ft. Super-Octave; and under this French name it is still found on old German and Swiss organs.

Dulcet. *See* Dolce.

Dulcian. A soft-toned basson-like reed of 8-ft. and 16-ft. tone, as a rule open, but sometimes stopped. Neither to be mistaken for Dolciano, which in the Frauenkirche at Görlitz was constructed by the builder, Buckow, as an open wood flue, nor for Dulciana, which both as 4-ft. and 8-ft. stop occurs frequently in English (Westminster Abbey) and French organs with Dolce intonation and wide scale. In the new cathedral organ at Riga it is placed on the first manual amongst the flue stops.

E.

Echo. When this word alone appears on the button, it indicates an exceedingly soft, flute-like stop, which is often

placed in a swell box, separate from the main body of the organ. (*See* Vox Humana.) It is sometimes labelled Bourdonecho.

Echo Organ. *See* Crescendo.

Electro-pneumatic Action. As it is not uncommon at the present date to meet with organs which are distributed in different parts of the church—as for example in the new electro-pneumatic organ at Forst, near Bruchsal, which I mention later on—I will say a few words on electro-pneumatics in organ-building, as being the only contrivance making such division possible. I saw this exhibited on trial at the organ-building works of F. Goll, and am convinced that electro-pneumatics have a great future in organ-building, for the following reasons: 1. Electricity makes distance of no consequence; the differences which arise between builder and churchwardens, the disputes about a foot or two of space, no longer occur, as the consol may be separated *ad libitum* from the main body of the organ, regardless of distance, and placed in the most convenient spot (the demands of acoustics must of course rank pre-eminent). The connection between keyboards and pallets is formed by means of an almost imperceptible cable. On striking the keys the divided parts sound with the same precision as if close together. 2. By means of electricity a whole host of levers, stickers, rollers, trackers, etc., become unnecessary, and the possibility of accidents to the mechanism, and the unfavourable influence of temperature on the works, are considerably reduced. 3. The cost of maintenance is reduced to the trifling minimum for electric batteries. The connecting and disconnecting of the electric current is obtained by the simplest imaginable process. As soon as the wind process

begins to act on the bellows, which are still required, the electric circuit is completed by means of suitable accessory bellows; it may, on the other hand, be quite as easily interrupted. It is important that the electric communication between consol and pallets should be materially assisted by small bellows, which act as pneumatic levers; hence the name Electro-pneumatic Action. The doubts reflected on this contrivance, as retarding the prompt articulation of the pipes, have no foundation. A specimen of an organ by Weigle, worked by an electro-magnet, unassisted by pneumatics, was exhibited at the Vienna Exhibition. Many an electro-pneumatic organ is already in action, for instance, in the new Catholic church at Forst, near Bruchsal, in Münster, canton of Lucerne, and one of forty-three stops in the Église St. Nyzier, at Lyons, where the organist sits at a distance of seventy-five metres from the body of the organ. Lastly, a new electro-pneumatic organ is in contemplation for the Philharmonic at Berlin, and for other places. For the present, however, Electro-pneumatic Action cannot be generally introduced, as the patenting of this invention (Organ-Building Department, Schmöle and Mols, amongst others) and the sudden and entire revolution of the existing workshops offer for the present, for conspicuous reasons, insurmountable difficulties, and as the invention, moreover, still lacks stability and guarantee. More particulars of the way in which the laws of acoustics are violated for the convenience of electric division will be found in the illustrated "Acoustics" by Chladni, whom Tyndall, in his book, "On Sound" (page 160), calls the father of all modern acoustics. Compare Tisco's paper, "The New Acoustical Apparatus" (Vienna, 1885), which contains, in addition to other matter, a complete list of books of reference on this subject. This

is the place in which to mention the very interesting hints by Pietro Blaserna, of Rome, on page 50 of his work on "Acoustic Agents in an Enclosed Space."

English Horn. A very beautiful horn-like solo stop, which occurs only on large organs as a striking reed, similar to Oboe. I found this stop particularly lovely in the Münster at Bâle, and on the Court organ at Lucerne. As an 8-ft. Cor Anglais it appears in the St. Eustache and Madeleine organs, Paris.

Equal Temperament. *See* Octave.

Euphonium. (From the Greek *εὐφωνια*, euphony.) An 8-ft. free reed, rather softer than Clarionet. A beautiful specimen of it is found in the Grossmünster at Zurich, and in the church of St. John, Schaffhausen. As 8-ft. Euphon it appears at Riga, and as 16-ft. pedal stop in the St. Eustache and St. Sulpice churches, Paris. (*See* Reed Stops.)

Evacuant (from the Latin *evacuare*, to empty) is a stop by means of which the organist, on ceasing to play, can relieve the bellows of all wind pressure.

F.

Fistula. (Lat.) An obsolete name for a reed pipe. It is of interest to know that the name of this stop, as applied to copper pipes in organ-building, was found in a manuscript of Bongars of the eleventh century, discovered by Prof. Dr. Hermann Hagen:—"De fistulis organicis quo modo fiant. Cuprum (Late Lat. for *cyprium*, copper) purissimum tundendo ad summam tenuitatem extenditur—reliquas (fistulas) ipsius ordinis sic facies ut superiores gravioris ordinis fecisti" (Catalogue of Manuscripts by Prof. Dr.

Hagen, page 83, B. 56. Town Librarian at Berne). (*See also* Gamba.) Also Dr. H. Riemann's "Organ-building in the Early Middle Ages," Leipsic allgemeine Musikzeitung, 1879. Michael Practorius, in his "Syntagma," Anselm Schubiger, in his "Spicilegien," and J. Seidel ("The Organ and its Construction," page 119) mention the Fistula Minima among the less used stops; J. Weippert as the name of a narrow scale Flageolet of thin intonation. (*See* Measurement.) For the derivation of Salicis Fistula, *see* Salicional.

Flachflöte (flat flute). A sharply intonated, broad-lipped 8-ft. and 4-ft. metal flute, arranged as a 2-ft. stop in the Benedictine Convent, Weingarten, and as a 1-ft. stop on the Catholic Court organ, Dresden.

Flageolet. A 1-ft. and 2-ft. flute-like open metal stop, often of wide scale, and fuller in intonation than the 2-ft. Octave. In large organs, and in the Swell box, it often occurs with mellow intonation under the name of Flageolet Echo.

Flautino. A small metal flue stop, often placed as a 2-ft. stop on the upper manuals for the brighter colouring of the whole of the manuals. In conjunction with the 4-ft. Gemshorn in the Echo box, it contributes largely to the more intense effect of the latter. It is evident that the existence of this, as well as of the former, and similar stops of smaller and the smallest possible kind, requires the presence of proportionately numerous 4-ft., 8-ft., and up to 16-ft. stops. (*See* Combinations of Stops.)

Flauto Amabile. *See* Flûte d'Amour.

Flauto Dolce, an 8-ft. and 4-ft. wood stop (sometimes of metal, viz. 1 part lead, 3 parts tin), is particularly mentioned here amongst the flues, because it is used with preference as a delicate stop on the first manual in new

German and Swiss organs. In combination with soft stops of every kind it renders most valuable service. In this treatise the Great manual is always understood to be the lowest one, although in some organs the second manual is so termed (Vienna, Geneva, Freiburg, Paris, and others). (*See* Combinations of Stops.)

Flauto Major. *See* Flute.

Flauto Piccolo, or **1-ft. Piccolo,** the smallest and acutest of all metal stops. (*See* Flautino.)

Flauto Traverso (German, **Traversflöte, Querflöte**) is a flue pipe over-blowing into its octave, intended to imitate the real orchestral flute. When constructed as a wood pipe, the body is hollowed out, and in place of the ordinary slit, a round opening is made, such as is found in the real flute for blowing into, and into which the wind enters through an orifice somewhat below the mouth-hole. Flauto Traverso is generally a 4-ft. and 8-ft. stop on the upper manuals, and, if built by a master hand, is a solo stop of delicious effect. In the large English organ, built for Sydney, the Flauto Traverso is represented three times on the manual of the Solo Organ, that is, as 8-ft., 4-ft., and 2-ft. tone. From c′ the Flauto Traverso is made double the length, and it has a little hole at the node of vibration, in order that the over-blowing note may never relapse into the foundation tone. Flauto Traverso makes a fine combination with Æolina and Lieblich-Gedackt, or with Oboe and Wienerflöte. As a solo stop, accompanied by Dolce, the Flauto Traverso is heard to great advantage. For its combination with Physharmonica, *q.v.* (*See also* Intonation.)

Flue Stops, Flute Work, Flue Pipes. As this name is frequently used for a whole family of stops in contra-

distinction from Reed stops, I will endeavour to give a concise definition, according to the latest results of study, on the generation of sound in flue pipes. The peculiarity of flue pipes is that, when they are sounding, air is the generating and vibrating body. The pipe only serves to cut off the vibrating column of air from the outer atmosphere, and to regulate the vibrations. The tone is originated at the sharp edge of the mouth (*labium*, lip); a flat current of air is driven against this lip, and in splitting produces a curious noise, which may be considered as a mixture of many tones in close proximity. (Compare Melde's "Acoustics," 1883, p. 250 and the following.) The bore of the pipe then stimulates some of those sounds which correspond to the tones peculiar to the pipe, thereby raising them to the rank of a musical note. (Even the tone of a tuning-fork, if brought into close proximity with the mouth of a tube, or an organ pipe, is strengthened if the pitch of the said fork corresponds to one of the notes peculiar to the pipe.)

Fig. 1 shows the longitudinal section of a wooden flue pipe. The vibrating column of air is cut off from the outer atmosphere and regulated by the sides R R. The air coming from the wind-chest passes through the foot of the pipe into the throat or air-chamber K, from which it can now escape through the narrow slit *c d*, and in being forced against the sharp edge, *a b*, of the mouth, produces the musical tone as above described.

Fig. 2, on the other hand, is a metal flue pipe, soldered at the top, therefore gedackt, or covered. It has purposely been placed by the side of the open flue pipe, to show the physical definition given under Gedackt (*q.v.*), according to which it gives a tone an octave deeper than does an open

pipe of the same length (Fig. 1). The letters R R, as above, indicate the tube which encloses the sonorous body of air; *a b* is the above-described site for the origin of the tone, and F F, the foot of the pipe standing in the sounding board, and extending to the slit. (See above.)

A definition of the production of tone in the flues is to be found in Richter's "Catechism of the Organ," p. 24, and in Sonreck's "Theory of the Sonorous Column of Air."

One word more on the difficult tuning of this species of pipe. Although I am quite of opinion that the tuning of flue pipes should really remain the business of the organ-builder, still I would here draw attention to the new contrivance for tuning with slots and rolled-up strips of tin (for metal pipes), or tuning sliders (for wood pipes). The main body of

Fig. 1.

Fig. 2.

the pipe is made longer by half a tone than the intended pitch requires; an oblong opening, proportionate to the measurement of the pipe, is then cut in the tube just below the upper end, in such a way that its lower half begins below the actual pitch of the pipe, while the upper half extends beyond it. The strip of metal, which is cut out to form the oblong opening, remains attached at the lower end, and is rolled up in a spiral. (Compare Prof. Kothes' excellent book on organ-building, to which I am indebted for several capital illustrations.) By rolling up the strip, and thereby shortening the working portion of the pipe, the tone becomes sharper; by unrolling the strip, that is, lengthening the pipe, the tone is made flatter. In wood pipes the same operation is performed by means of a movable slider, retained in position by two screws. The tuning slot gives the pipes, apart from a precise articulation, a more steady, decided tone, and adds power of expression to its qualities. This mode of tuning must, however, not be confounded with tuning shades of older date, which served exclusively to facilitate the operation of tuning.

Fig. 3.

Fig. 4.

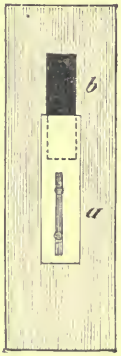


Fig. 3 shows the upper end of a metal pipe, on which is visible the tuning slot, *a*, and the strip of metal, *b*, rolled up in a spiral.

Fig. 4 shows that side of the upper end of a wood pipe at which the tuning slider, *a*, is pushed up as far over the opening, *b*, as the dotted line goes.

In new organ contracts, this tuning-slot arrangement is

often stipulated for, particularly for the Principal and Gamba stops.

The open wood pipes are tuned by means of a tuning shade of zinc or tin plate, bending up or down; and the metal pipes—for instance, the small mixture pipes which have no tuning slot—are tuned by means of a tuning horn. By narrowing the upper rim of the pipe the tone is flattened; by opening it out, it is sharpened. For tuning stopped pipes, *see* Gedackt.

Flute. When this name alone is placed on the button of a stop, it means an open, particularly wide 8-ft. and 4-ft. flue pipe, louder than Flauto Dolce (Flauto Major, as 16-ft. stop on the Great manual at Riga). Flute is the foundation of a large species of stops, several of which, such as Fernflöte, Blockflöte, Spillflöte, Nasonflöte, Suabeflöte, Bauerflöte, etc., are becoming extinct in new organs. It is evident that in organs of one hundred or more stops (Ulm, Paris, Liverpool, London, Sydney, Russian Libau, Riga, Garden City, U.S.A., and a few others), some names for the same or a similar stop may occur with slightly altered etymology, solely for purposes of distinction. In the same manner as has just been done with Flauto Dolce, other members of the Flute family are discussed in this work. Three-cornered Flutes have also been employed, partly on account of limited space, partly because the desired intonation necessitated a wider lip. Combined with others, it is rather more effective than Flauto Dolce. The 8-ft. Flute as pedal stop occurs under the name of Bass Flute on nearly every pedal clavier. As we mentioned at the end of the article Sub-Bass, the Flute Bass and the similar-toned Octave Bass give the pedals in the lower registers not only great precision—a quality particularly

belonging to the Violoncello—but also more body, and in the upper registers the fullness and roundness so often wanting in Sub-Bass.

Flûte à Cheminée. *See* Rohrflöte.

Flute Bass. *See* Flute.

Flûte d'Amour (**Flauto Amabile**) is a charming wood flue stop of slender scale, arranged as 8-ft. and 4-ft. tone; in Switzerland more frequently as 4-ft. tone. According as the rest of the pipes are arranged, it occurs on the first manual in many organs, where it is very useful as a solo; for example, in the new organ of St. Martin's Church, Vevey, and in the German Church at Montreux. The sombre Gedackts and the strings (*see* Æolina) are effectively enlivened by it. It is often found as 8-ft. Amorosa on Steinmeyer's organs.

Flûte Douce (**Sanftflöte**). *See* Wienerflöte.

Flûte Harmonique. *See* Harmonic Flute.

Flûte Octaviante. *See* Harmonic Flute.

Flute Principal. An 8-ft. stop of a pleasant, bright, fluty tone. Occurs in many organs to great advantage on the second manual, and combines very prettily with Salicional or Viola, and an enlivening Flauto Traverso.

Frein Harmonique is an arrangement, invented by Gavioli of Paris, applied to narrow scale stops (Gamba, Violoncello, Viola, etc.), by means of which the ready, incisive, string character of the tone is considerably strengthened and beautified. This contrivance consists (Dienel) of a narrow metal plate, of the length of the mouth, fixed obliquely to the latter on an adjustable spring. I have referred (*see* Gamba) to the effectiveness of this Frein, which answers even in the case of the smallest scale string stops.

Fugara has much in common with Gamba, while in

quality of tone it stands between this and the Geigen-principal. It occurs as 8-ft. and 4-ft. tone.

Furniture is the French name for our Mixture.

Fig. 5.

Gamba. Length and pitch the same as 8-ft. Principal, width (presupposing an 8-ft. Gamba) the same as 4-ft. Octave.

G.

Gamba, or **Viola di Gamba** (German, **Kniegeige**), is an eminently characteristic organ stop, found at the present date as 8-ft. stop on every Great manual, besides occurring in very large organs as a 16-ft. stop. On the cathedral organ at Riga (124 speaking stops), it occurs on the Great manual as 16-ft., 8-ft., and 4-ft. tone simultaneously. Its intonation is stringy, and shriller than that of Salicional. A Gamba of ready speech, and possessing these qualities strongly developed, is one of the most satisfactory results of the modern art of organ-building. (*See* Intonation.) The pipes have a narrow aperture between the lips and narrow gauge (Fig. 5), and are therefore constructed longer than Principal or Salicional pipes. The proportions of the 8-ft. Gamba are taken from those of the 4-ft. Octave, and the length of C, for instance, is 8 ft. 3 in.* It is made chiefly of best English tin. A conical Gamba is called Cone-Gamba. In examining an organ the other day, in the capacity of an expert, I found the lower ranks of the Gamba, which were made of wood, lying horizontally for reasons of space, without in the least

* Prof. Zellner, of Vienna, writes to me: "Rieger of Jägerndorf constructs metal Gambas which are exceedingly narrow (11 mm.—$\frac{11}{16}$ in. diam. for a'). They have the Frein Harmonique (*q.v.*), and, under increased pressure, speak with great precision."

thereby losing colour or power. In Spain, horizontal ranks are not unfrequently met with. The wider, and therefore more powerful, Gambas found in some places cannot be so highly recommended as the narrower and weaker ones, which possess the real incisive Gamba tones, unless Viola and Salicional supply this want. (*See* Geigenprincipal.) Although a Gamba of the above-mentioned qualities requires no addition to be wonderfully beautiful in effect, I would still recommend—should a flute-like character be desired for this string-toned stop—a richly voiced Gedackt, Hohlflöte, Rohrflöte, and Flûte d'Amour. (*See* Combinations of Stops.) In the construction of such metal stops as are not visible, a moderate alloy of tin and lead (*see* below) is not only permissible, but is indeed quite the rule. With regard to the historical development of pipes, and the materials which in turn have been employed (*see also* Fistula), I refer the reader to my collection of notes which came out in the *Alpenrosen* (Series 1878, C. Locher's "History of the Organ"). In the terminology of the organ, the terms "pure English tin," "tin," and "metal" often occur, by which is simply meant the proportion (alloy) in which lead has been added to the pure English tin. We have pure English tin (instead of which an alloy, containing $\frac{1}{15}$ of lead, is unfortunately still often employed); further, the common English tin (proportion 2 : 14); probe-tin (4 : 12); and metal, of which one-third, often even one-half, is lead. It is apparent that these proportions are subject to modifications according to the practice of the organ-builder in question and the varying conditions of the contract. Only absolutely purest tin ought to be employed for the front pipes, even should the contract become more expensive in consequence; instead of the sil-

very polish (*see* Principal), which is the chief ornament of the front, the alloy pipes show in course of time a blueish tint, or even worse, sugar of lead. (Compare Zamminer, "Musical Instruments in their Relation to Acoustics," p. 261 and the following, and Prof. von Schafhäutl's "Experiments with Metal, Wood, and Pasteboard," for further particulars on material for pipes, and its influence on sound.)

Gedackt, or **Gedeckt** (covered, stopped), if a wood pipe, is plugged with a leather-covered stopper (Fig. 6); if a metal pipe (Fig. 7), it is a 4-ft., 8-ft., 16-ft., and 32-ft. flue stop,

Fig. 6.

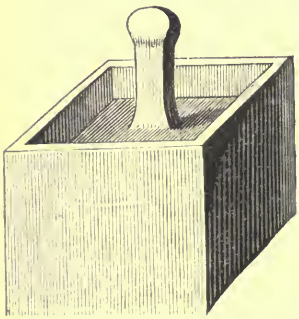
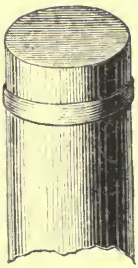


Fig. 7.



covered with a metal lid. Gedackts form one of the most important families of stops, which is evident from the fact that Bourdon and Sub-Bass belong to them. The terms Lieblich-, Sanft-, Still-, Gross-, and Grob-Gedackt depend upon the power of intonation and the dimensions of the pipes. The 8-ft. Lieblich-Gedackt is built by some masters with double lips from g upwards. A refined Lieblich-Gedackt, cleverly intonated by a master hand, forms one of the most fascinating organ stops on the Swell, and admits, as hardly any other does, of a tasteful use of the Tremulant (*see* Tremulant). (*See* Sub-Bass for the use of the Gedackts as pedal

stops.) Every stopped pipe may be looked upon as an open pipe cut in half at the node of vibration (Töpfer). It gives a tone an octave deeper than the open pipe of the same length, because the column of air set vibrating in the covered pipe has the same distance to travel to the lip, as if the pipe were open and as long again. Stopped pipes of very wide scale give, when softly blown, the foundation tone almost true, whereas narrow Gedackts allow the twelfth to be distinctly audible (Helmholtz). (*See also* Quintaten.) A double-lipped Gedackt (*see* Double Flute) sounds proportionately brighter and stronger than the single-lipped one. No large organ should be without the 16-ft. Lieblich-Gedackt on its upper manual, for the same reason that a responsive 16-ft. Bourdon is recommended for the first manual. A beautifully effective specimen is that in the Catholic church at Berne. Gedackts form a good foundation, and can be combined with anything that lacks fullness and sombre colouring. (*See* Bourdon and Combinations of Stops.) If, however, one wanted to play a polyphonic composition with its dissonances only on the Gedackts, it would all sound equally colourless, and, for that reason, without character or energy (Helmholtz). (*See also* Tone Colour.) In tuning the stopped pipes, which should be the organ-builder's affair (*see* Flue Stops), the pipe is lengthened by raising the stopper or the lid; by pushing the latter down, the bore is made shorter, and the tone consequently sharpened.

Geigenprincipal. A metal stop of very narrow scale, occurring as 16-ft. (Riga for instance), 8-ft., or 4-ft. stop on the upper manuals, where, on a smaller scale, it is often required to take the place of the Principal. It has a rather incisive, violin-like tone. In the narrow flue pipes, which naturally

require a strong wind-pressure (Geigenprincipal, Violoncello, Violon Bass, Viola di Gamba, etc.), the foundation tone is accompanied loudly and distinctly by a number of harmonics, which, according to Helmholtz ("Sensations of Tone," p. 151), lend to the tone its stringy quality.* Geigenprincipal gives the round organ-like tone to the Swell Manual, so often supplied only with far-fetched would-be characteristic stops; and as 8-ft. tone it combines favourably with 4-ft. Gemshorns in rapid passages. Bergner, organist at the Riga Cathedral, considers 16-ft. Geigenprincipal most effective with 8-ft. Spitzflöte. (*See* Combinations of Stops and Tone Colour. *See* Diapason for the term Violin Diapason, as applied to the Geigenprincipal in American organs.)

Gemshorn is a metal stop resembling the Principal, with a precise, rather horn-like tone; the pipes taper upwards to a point. It occurs as 8-ft. and 4-ft. tone, and in power about equals Geigenprincipal. A bright, singing Gemshorn, along with 8-ft. Geigenprincipal, produces intensity of tone in the Swell. There is a 2-ft. Gemshorn in the new organ at the Hague, Holland; and in Westminster Abbey (W. Hill) there is a 2-ft. Harmonic Gemshorn. (*See* Harmonic Flute.)

Gemshornquint. *See* Quint.

Grand Bourdon. *See* Double-stopped Bass.

Great Organ. Prof. R. Palme, of Magdeburg, is right in drawing my attention to a fact which I have often observed myself, viz. that when organists meet with the indication "Great Organ," they blindly draw all the stops they can well lay hold of. I dare say that it will only

* The real Principals of wide scale which allow of stronger wind-pressure without over-blowing, give the foundation tone full and loud with the more delicate accompaniment of the upper pedals, and form, therefore, the bulk of foundation sounds of the organ.

require this critical hint from the master to remind beginners that under the term "Great Organ" is still often allowed a suitable omission of certain reeds and "screamers," and that a but partial use of groups of stops in accordance with the character of the piece to be played is not excluded. (*See* also Combinations of Stops.)

H.

Harmonia Ætheria. *See* Harmonica.

Harmonica, a very tender 8-ft. string-tone stop of narrow scale, intonated between Æolina and Salicional, is a delicate solo voice usually placed on the third manual in large organs (Frankfort-on-the-Main, Ulm, Leipsic, Lucerne). In Frankfort-on-the-Oder it occurs under the name Flöte-Harmonica, 8 ft., and in Canterbury under that of Harmonica Flute, 4 ft. It combines splendidly with Bourdonecho. It must not be confounded with Physharmonica (*q.v.*), nor with the mixtures Progressio Harmonica (Lübeck, Grafenrheinfeld, Merseburg) and Harmonia Ætheria (ex. Echo Organ of the cathedral organ, Riga, and Nicolaikirche, Leipsic), both of which are arranged as particularly delicate mixtures on the upper manuals. (*See* Reed Stops for the so-called chemical Harmonica, so important for acoustical experiments on the generation of tone in organ pipes.)

Harmonica Bass. An exceedingly delicate, softly string-toned, 16-ft. wooden pedal stop, corresponding in strength to the softly voiced Salicet-Bass, or 16-ft. Salicional (*q.v.*), on the pedals. As solo or in combination with 16-ft.

Sub-Bass (*q.v.*) it is specially suitable for the accompaniment of soft passages. A fine specimen is that, for instance, in the Catholic Church at Berne.

Harmonica Flute. *See* Harmonica.

Harmonic Flute, Flûte Harmonique, is, briefly, an over-blowing Flute of the nature of our Flauto Traverso, very frequently arranged as 4-ft. stop (*q.v.*), in which case it is called Flûte Traversière Harmonique. On account of its over-blowing, it is also frequently called Flûte Octaviante, Trompette Harmonique, Flageolet Harmonique, etc. It will be seen from the arrangement of French organs of what value the French consider these Jeux Harmoniques, based upon the utilization of harmonic tones. The Jeux Harmoniques frequently represent one-sixth of all the stops. Further scientific notes on the subject, in which special attention is given to French organ-building, are to be found on p. 75 and the following of Adrien de la Fage's "Report to the Société des Beaux-Arts, Paris." In that most magnificent organ for Sydney, now in course of building at W. Hill and Son's works, London, the largest ever built for any English colony, the Harmonic Flutes and Trumpets are ingeniously incorporated in the tremendous army of 126 speaking stops. This English organ will certainly be one of the most remarkable, both as regards tone and mechanical requirements. (*See also* Trombone.)

Friedrich Ladegast, builder of the Nicolai organ, Leipsic, writes on the subject of the harmonic tones of pipes (Töpfer, vol. ii. § 619): "It is known that these tones have a power and fullness which can never be obtained by ordinary pipes speaking in the foundation tone only. The air column of such pipes as give harmonic tones is divided into two, three, four, or more vibrating sections. The tone

improves in quality, and may be strengthened without becoming shrill, and the whole stop receives uniformity." This reminds me also of the apparatus which Dienel found in the workshops of Cavaillé-Coll, and which he described in the *Urania* for 1878, No. 12. This apparatus demonstrates the effect of harmonics on the foundation tone, and gives a clear list of the names of harmonic tones, the number of sound-waves per second, and the metrical length of the waves. Compare König's apparatus, described by Pietro Blaserna of Rome on p. 211, Fig. 36, which is based on the principle of Helmholtz's resonators. By means of his eight resonators, each of which acts through an elastic membrane on easily affected gas-flames, it may be proved (1) that all musical instruments have harmonic tones, and (2) which these harmonic tones are. (*See also* Tone Colour.)

Harmonic Trumpet. *See* Harmonic Flute.

Harmonics. *See* Harmonic Flute, Geigenprincipal, Tone Colour, Mixture, Octave, and Quint.

Harmonium. *See* Physharmonica.

Hautbois. *See* Oboe.

Hohlflöte (hollow-tone flute). An open, wide-scale wood stop of a round, rather colourless fluty tone, generally as 2-ft., 4-ft., and 8-ft. tone on the manuals, and arranged as Quint stop, labelled Quintflute, Hohlquint (hollow quint), of $5\frac{1}{3}$-ft., $2\frac{2}{3}$-ft., and $1\frac{1}{3}$-ft. tone. It occurs also as 1-ft. Sifflöte and as 16-ft. Grosshohlflöte. As a particularly rare specimen I found this stop in Ulm Münster as a 2-ft. pedal stop, where, combined with other stops on the upper pedal, it gives, without need of any coupler, a power of expression belonging almost exclusively to the manuals. To explain the term "upper pedal," I must say that at Ulm, as well as in the church of St. Paul, Frankfort-on-the-Main,

in the Marienkirche, Lübeck, and in the Stiftskirche, Stuttgart, there are two pedals placed one above the other (like the manuals) instead of the customary single pedal. This arrangement has been superseded by the present convenient composition and combination pedals. Hohlflöte with Gamba give a felicitous, somewhat horn-like combination.

Horn. An 8-ft. reed, intonated between Bassoon and Trumpet (Sydney), frequently resembling the English Horn (*q.v.*).

I.

Intonation. (From the Latin *intonare*, to resound, or, in a transitive sense, to cause to sound.) Intonation (the real art in organ-building, unfortunately so often treated as a minor consideration, and also paid as such) is a term which occurs frequently in this work in the articles both on Flues and on Reeds, and which I will therefore endeavour to define by a very few words. The intonation of an organ is one of the most important operations, because the tone (in the proper sense of the word) of the instrument depends upon it. The whole instrument may be very well built, the pipes may be of very good material and very accurately executed, and yet one may not be able to call the organ very excellent, if the effect of each single tone, as well as of the general tone, does not correspond with the faultlessness of the rest of the work. The result of a masterly intonation is: (1) the correct character for each species of pipe; (2) an easy and ready speech. Topfer (vol. i. § 1160) expresses himself happily: "It is

generally much more difficult to combine good speech with good tone, than to separate them; it is, therefore, easier to obtain a good tone if one is satisfied with slower articulation." Gamba and Salicional, for instance, offer an eloquent proof of the progress made in articulation and intonation generally. (*See* Frein Harmonique.) (3) The possibility of giving the pipe a colouring of tone suitable to its character and denomination (*see*, for instance, Trumpet, Flauto Traverso, Oboe); (4) the careful equalizing, in all registers, of the degree of sound to suit the building; and (5) the proper temperament (*see* Octave), and thoroughly complete tuning of the organ, which should more correctly come under the head of tuning. (*See also* Tone Colour and Reed Stops.)

J.

Jeux de Fonds. *See* Shut-off Valve.

Jubal Flute. (Called after Jubal, the father of music in the Old Testament, Genesis iv.) A double-lipped powerful Flute, sounding open and bright, similar to the Double Flute, which is also double-lipped. I found this stop on the first manual in St. Paul's Church, Frankfort-on-the-Main; and, labelled Double Flute (*q.v.*), as 8-ft. stop—seldom as 4-ft. or 2-ft. stop—on some of Weigle's instruments. As already remarked with regard to the Double Flute, the Jubal Flute has an enlivening effect, if combined with a fine string-tone stop.

K.

Keraulophon (from the Greek κεραύλης, the horn-blower), is a flue, belonging to the family of Geigenprincipals. It has an exquisite horn-like intonation, and is much used in large new organs, as, for instance, by Roosevelt (New York), 1879, in the Garden City organ (118 stops); by Steinmeyer of Oettingen, 1880, in the Frauenkirche, Munich; and by Hill in Westminster Abbey, 1884; and almost simultaneously by Merklin (Lyon), in the church of St. Eustache, Paris.

Krummhorn. *See* Cormorne.

L.

Larigot. An antiquated denomination for a very shrill, piercing Quint of $1\frac{1}{3}$-ft. tone, with a very wide mouth.

Lieblich-Gedackt. *See* Gedackt.

M.

Material for Pipes. *See* Gamba.

Measurement. (From the Latin *metior, mensura*, measure.) The manuscript of the eleventh century, mentioned under Fistula, gives proportions for measurements: "Reliquas fistulas ipsius ordinis sic facies ut superiores gravioris ordinis fecisti." The expression "Measurement," as frequently used in this work, means all dimensions of organ pipes, length, width, as well as cutting up. All these dimensions materially influence the pitch, power, tone

colour, and speech of the pipes. The object of making a pipe wide is to obtain a strong, round, thick tone, not easily over-blowing even in the shortest kind of pipe; beside which, wide measurements are in proportion to large buildings. A narrow scale gives a more stringy, incisive, and Gamba-like colouring of tone (*see also* Geigen-principal), and a more readily over-blowing tone, and also that particular brilliancy and acuteness peculiar to certain stops; it is suitable, under certain conditions, for a small building, and for such upper manuals as make no pretence to fullness of tone.

Melodia is an 8-ft. wood flue, labelled Double Melodia when of 16-ft. tone. It is intonated similarly to Flauto Dolce, and much used in new English and American organs. It occurs as 8-ft. Melodia in the cathedral organ at Riga.

Metal. *See* Gamba.

Mixture. (From the Latin *mixtum*, *miscere*, to mix.) The theorist is inclined to reject the idea of a contrivance by which the higher harmonic fifths and thirds, sounding with each foundation tone, must bring hideous dissonances into every harmonious weft. Practical reasons, however, compel organist and organ-builder to retain these Mixtures. Their purpose is to produce harmonics which exist in a lesser degree in the foundation stops of the organ than, for instance, in the instruments of an orchestra, which latter, therefore, require artificial harmonics much less than does the organ. Even the orchestra, according to Diene1, cannot quite do without artificial harmonies; considering that the strengthening by unisons and octaves is nothing more nor less than the skilful utilization of harmonics, or partials, such as the 4-ft. and 2-ft. stops of the organ produce. Well-composed Mixtures, supported by a practical

arrangement of stops, and correctly employed, are a most effective addition to musical resources. To prevent the Mixture stop from being intolerably harsh, it is necessary proportionately to strengthen the lower tones of each note by other stops (Helmholtz, p. 98). It is on this account that, in small organs with insufficient covering, the Mixtures jar by the excess of harmonics. (*See* Octave.) The Mixture often repeats (*see* Cornet) in the tenor and middle octave. The 5-rank Mixture, for instance, based on C, is composed of c (4-ft.), g ($2\frac{2}{3}$-ft.), c (2-ft.), g ($1\frac{1}{3}$-ft.), c (1-ft.), or of g ($2\frac{2}{3}$-ft.), c (2-ft.), g ($1\frac{1}{3}$-ft.), c (1-ft.), g ($\frac{2}{3}$); the fourfold and threefold Mixtures are reduced accordingly by one or two ranks.

In order to lend greater volume and power to the Mixture, particularly in the absence of a Cornet, and if the foundation tones are not sufficiently represented, the Tierce is added; but not as highest tone, as in the Cornet, but rather in the middle register, as is the case in Sharp (for example, in the Catholic Church, Berne, where it has six ranks in the upper octaves). Walcker writes me word that he always employs the Tierce in Mixture, and in so doing obtains a more uniform effect. The Mixture stop occurs often labelled Progressio), particularly on German organs (quite in half the cases), as through, that is to say, non-repeating voice, and as such is generally of from two to five ranks, composed respectively of $2\frac{2}{3}$-ft. and 2-ft.; of 4-ft., $2\frac{2}{3}$-ft., and 2-ft.; and, finally, of 8-ft., $5\frac{1}{3}$-ft., 4-ft., $2\frac{2}{3}$-ft., and 2-ft. (examples in Switzerland: Engelberg Convent, and church of St. John, Schaffhausen). The Mixture is no good without sufficient foundation tones, because it contains the loud sounding harmonics; it belongs, therefore, to the Great Organ only, and has no right

to be ever used separately. On the other hand, the great value of a well-arranged and properly covered Mixture has, as already mentioned, been long recognized. It lends to the whole organ energy and decision, to the lower tones distinctness, and to the Great Organ a silver-like brilliancy. Among the old organ-builders, Gottfried Silbermann (died 1753, at Dresden) was principally successful in employing this stop, and obtaining for it due recognition. His organs in the Catholic Chapel Royal and the Frauenkirche, Dresden, are still much admired. Zamminer writes, "There seems to be a disinclination to dispense with the sharp incisiveness which the clear shrill Mixture pipes add to the bulk of the sounding organ, and to which they stand in the same relation as spice does to food." I have to thank this same scholar for the correct estimation of theory and practice, with regard to the stop, with which I headed this paragraph. The material for Mixture stops is chiefly spotted metal (an alloy of tin and lead; *see* Gamba), or metal, as this compound is called in German organ-building. (*See also* Combinations of Stops.)

Montre (from the Latin *monstrare*, to show) is the name given by the French to the visible, or front, Principals. I met with the names Montre and Montre Echo on the Great Organ at Freiburg (Moser); and on the Münster organ at Geneva I found the names 16-ft. Principal, 8-ft. Montre, and 4-ft. Prestant on the same manual. (*See* Octave.)

Musette. *See* Schalmei.

N.

Nassat (Nazard). A stopped flue pipe, usually occurring as a Quint stop of $5\frac{1}{3}$-ft., $2\frac{2}{3}$-ft., and $1\frac{1}{3}$-ft. tone. Grossnassat, $10\frac{2}{3}$-ft., produces a 32-ft. tone if combined with 16-ft. Principal (*see* Quint). It is found on some of Haas's large organs.

Night Horn. As a rule a large scale horn-like pedal stop (as 4-ft. stop, for example, in the Breslau Cathedral and the Berlin Garrison Church). It is found on the manuals as 8-ft. and 4-ft. tone; and as a rarity of 2-ft. tone, it occurs in the Benedictine convent at Weingarten.

O.

Oboe, Hautbois, is a very frequent 8-ft. reed stop, striking as well as free, and occurring only on the manuals. It represents, although unfortunately not always, the wind instrument of the same name (and is therefore called, as in Westminster Abbey, Orchestral Oboe), particularly in the upper octaves, where it often forms the continuation of the Bassoon (*q.v.*). In the St. François organ at Lausanne, and at Glarus, the Oboe is arranged as a free reed with a swell of its own. A rarer kind of Oboe, of 4-ft. tone, is placed in the cathedral at Riga, and as Octave Oboe in the Town Hall organ for Sydney, now in course of building by W. Hill and Sons, London. If built by a master, the two stops, Oboe and Clarionet (*q.v.*), make splendid solos, and are an ornament to any organ. When there

is a possibility of keeping them in tune I do not like to find any organ without Oboe and Clarionet, even if it have only eighteen or twenty stops. (*See* Reed Stops.) The combination of Oboe with 8-ft. Wienerflöte and 4-ft. Flauto Traverso produces a charming effect, coupled with Flauto Dolce or Bourdon on the first manual, with Sub-Bass and Harmonica Bass, or the latter only, as a foundation. (*See* Combinations of Stops.)

Octave, Prestant, Diapason. This stop is on every organ without exception, and adapts itself to the Diapasons in character, intonation, and size. The first Octave must be half as large as the largest Diapason, the second Octave must be half as large as the first Octave, and so forth.* A 16-ft. Principal, therefore, requires for the completeness of arrangement the 8-ft., 4-ft., 2-ft., but seldom 1-ft. Octave. As 2-ft. and 1-ft. tone it is often called Super-Octave. An 8-ft. Octave Bass (and, if possible, a 4-ft. Octave Bass for the performance, for example, of Bach's trios, with a cantus firmus on the pedal) is therefore necessary to the 16-ft. Principal Bass (as pedal stop). The Octave stops are sometimes called Prestants (from the Latin, *praestare*), when placed in the front (like the corresponding Principals). The Octave stops serve to strengthen the first harmonic, and therefore give more energy and clearness to the larger and deeper Principals. In very small organs, where Mixtures cannot be afforded, bright Octaves are absolutely necessary for the clearness of the stop. Where funds will allow, the 2-ft. Octave should never be missing in any but the smallest organs, it being a support to the Mixture stops,

* The calculations as to measurement are, it is true, mathematically not absolutely correct (compare Meldo's "Acoustics," 1883, p. 277), but may be accepted as such in the technique of organ building.

although already contained in the latter. (*See* Mixture and Flautino.)

The 4-ft. Octave on the Great manual is one of the most important of all organ stops, and is rightly termed in England the 4-ft. Principal (*see* Diapason), which it in reality is. This stop is generally used as the starting-point for tempering the organ. An alteration in the cycle of fifths must be made in such a manner that the twelfth fifth becomes identical with the foundation tone, or with one of its octaves; which result is obtained by tuning each fifth a trifle flat. By these slight deviations from perfect attunement, beats (or pulsations of sound) are created, and hence the term described in German as "Temperament with equal beats," commonly known as "Equal temperament." The fifth is first correctly attuned, and then flattened till it gives a slow pulsation. (See Töpfer, vol. i. p. 827 and the following, on Temperament, and on Heinrich Scheibler's mathematical tuning, according to differences of vibration.)

By presupposing the Paris pitch, adapted by the Conference for deciding pitch at Vienna, the a′, which is mentioned in every organ contract, makes eight hundred and seventy vibrations per second at 12 Reaumur (15° Celsius = 59° Fahrenheit). Compare Blaserna's "Sound," p. 87.

By taking as basis C′ the so-called physicists' C′, suggested by Sauveur, adopted later on by Chladni, of 512 simple or (French) half-vibrations (explanation follows), to which a tuning-fork, a′, of 853⅓ vibrations would correspond, the following numeric proportions, derived from the multiples of 2, are obtained: 32-ft. C′ with 32; 16-ft. C′ with 64; 8-ft. C′ with 128; 4-ft. C′ with 256; 2-ft. C′ with 512; and lastly ½-ft. C′ the highest C′ on the organ having

16,000 half-vibrations per second (ex. Riga). Compare Du Hamel's "Organ-Builder," vol. iii. p. 137.

This is the proper place to mention the very interesting way in which one has succeeded, by means of the Double Siren (invented by Seebeck, improved upon by Cagniard de la Tour and Dove, and in its present form constructed by the great physiologist and physicist, Helmholtz), in determining with mathematical exactness the number of vibrations per second of a chord, an organ pipe, or a human voice. Long before there was anything known of vibrations and their calculations, Pythagoras (580–500 B.C.) had discovered that if you divide a string by a bridge in such a way that the two parts produce consonants, they must be divided as 1 to 6. If the string be divided so that two-thirds of the string remain on the right, and one-third on the left, this proportion of length—1 to 2—gives the interval of an octave; just as the proportion 2 to 3 gives the fifth, 3 to 4 the fourth, 4 to 5 the major third, and 5 to 6 the minor third. (The proportions of the inversions are obtained by doubling the smaller figure of the original interval.)

It was not until much later that it was discovered (Mersenne), from the laws regulating the movements of strings, that the simple proportions of length in strings apply in an equal manner to the number of vibrations of tones; therefore to the intervals of tone on all musical instruments, and also to that immediately under our notice, the organ. I have mentioned by way of example the simple relative vibrational numbers of the various octaves founded on C. Excellent illustrations, furnished with correspondingly clear explanatory text, of Helmholtz's Double Siren, to which we owe such exceedingly important results in physical acoustics, are found in Helmholtz's

"Sensations of Tone," part ii., chap. viii., p. 242; and in Tyndall's "Lectures on Sound," vol. ii. p. 91. I recommend the latter to my English readers, as the best work on this subject in the English language. Compare the chapter on Reed Stops and Sirens in Melde's "Acoustics," sect. 94, and in Blaserna's "Theory of Sound," p. 120.

In illustration of the above-mentioned vibrational numbers, that for instance of 870 for a′, I must add that, according to Tyndall, English and German physicists call a vibration a complete oscillation of the vibrating body, the wave of which bends the drum of the ear first inwards and then outwards. A French physicist, on the other hand, calls a vibration a backward or a forward motion of the vibrating body in one direction only. We have therefore to distinguish between whole vibrations and half-vibrations; and as the Paris pitch (adopted by the International Conference at Vienna) goes by the latter, I have given the numbers accordingly. The a′, for instance, mentioned as having 870 (French) vibrations, would have 435 complete German vibrations; the 32-ft. C would have 32 (French) vibrations, but only 16 complete German ones.

Octave Bass. *See* Flute Bass.

Octave Coupler engages the higher octave of the stop drawn on the manual (specimen: Petrikirche, Hamburg).

Ophicleide. An 8-ft. stop. This name, which at the first glance appears rather far fetched, is simply derived from the orchestral instrument Serpent (Greek ὄφις, the snake; hence the name), which stop is still called Ophicleide in France. It is a reed stop, frequently found on the Great manual, as well as on the Swell, in large new organs (Riga, Boston). Its intonation is like that of the Clarionet, and its degree of strength is proportionate to the manual on

which it stands. An Ophicleide occurs as pedal stop of 16-ft. tone in Canterbury Cathedral, and in the organ at Garden City, U.S.A.

P.

Pasteboard as material for pipes. See Reed Stops.

Pedal Swell. *See* Crescendo.

Physharmonica is a very soft 8-ft. free reed stop, in which the metal tongue, instead of striking on the edge of the groove, vibrates freely within the groove. It is placed in a box, and has no real tube. If the Physharmonica has an appropriate swell, the most wonderful effects can be produced with it. It is arranged as 8-ft. and 16-ft. stop, with bells, in the Münster at Freiburg, Switzerland. (*See* Reed Stops.) In the cathedral organ at Magdeburg, there is an 8-ft. Harmonium, identical with the Physharmonica here described (Palme). A well-known effect is obtained by combining a good 4-ft. Flauto Traverso with an 8-ft. Flauto Dolce, accompanied by a Physharmonica with a tasteful Crescendo and Decrescendo. (*See* Combinations of Stops.)

Piccolo. *See* Flauto Piccolo.

Piffaro. A bright 2-rank flute of 4-ft. and 2-ft. tone.

Pneumatic Action. The pneumatic lever—that is, a lever set in motion by air—is a mechanical mediator between the pressure on the keys and the resistance of the trackers and pallets. In a box filled with air and hermetically closed, there are as many little bellows connected with the trackers as there are keys on the manual, and the finger has only

to apply sufficient pressure to raise a little valve. Particulars of this invention of the Englishman Barker, which considerably facilitates playing, even with couplers, will be found in Töpfer, vol. i. p. 542 and following, and in Richter, chap. xiv. Latterly Pneumatic Action has been successfully applied to Combination Pistons (*q.v.*).

Pneumatic Combination Pistons (buttons) have, particularly in England, and lately also in Germany and Switzerland, been placed above or below the corresponding manual. When pressed by the finger they push out a group of stops attached to them, without interfering with the organist's previous arrangement of stops. In this place should be mentioned the so-called stop key-board, which in some organs takes the place of the buttons.

Portunal Flute. An exceedingly rare open-wood flue pipe of 8-ft. and 4-ft. tone; which, meaning Bordunal Flute, is undoubtedly derived from Bordun.

Principal (Fig. 8), called Montre in French, is the chief flue stop, found without exception on every organ. It is always made of the best material (*see* Gamba), and forms, tastefully arranged in front (*see* Electro-pneumatic Action), the chief outer ornament, as well as the foundation for the whole tuning. The most approved way of building a Principal pipe is to make it of pure

Fig. 8.

Principal. Pitch coincides with that of the same length Gamba in Fig. 1, which is of slender scale in order to obtain the Gamba string-tone.

English tin, giving it a high silvery polish. (*See* Fistula.) If an organ has two or more manuals the Principals are made of different dimensions. On an organ of two manuals, for instance, the Principal of the Great manual is of wide scale, and that of the upper manual of smaller scale (Geigenprincipal, *q.v.*). On medium or small organs, the Diapason of the Great manual is always of 8-ft. tone; that is to say, the lowest note of this row of pipes—getting smaller as they ascend—is about 8 ft. (An exception is made in the case of front pipes, which are lengthened in order to obtain symmetry of outline, and are cut open behind at the point where the pipe proper ends.) I met with an 8-ft. Principal in my travels, which, owing to limited space, was arranged acoustically for the lowest manual tones with the 8-ft. Gedackt, and with a mellow wooden 4-ft. octave stop, and I did not discover great disadvantage arising from this combination. Very large organs often have both a 16-ft. and an 8-ft. Principal on the first manual. In the organ of St. Denis, by Cavaillé-Coll, is found a rare specimen, viz. a 32-ft. Principal on the second manual, which latter is sometimes called the Great manual (Paris, Geneva, and others). On the pedals the Principal is found, even in medium-sized organs, as a 16-ft. stop. As an exception I found, on a very good organ in Jersey, an open 16-ft. pedal stop, labelled Grand Open Pedal, which alone counterbalanced the three manuals. This stop resembles in size and power the corresponding pedal stop in the church of St. Laurence at St. Gallen (the latter organ presents the peculiarity of extraordinarily large keys). This peculiar proportion of the pedal stops is also found in large American organs. An arrangement by Roosevelt (New York), for example, only shows one Principal Bass of 16 ft.,

one Sub-Bass of 16 ft., and one Violoncello of 8 ft., amongst 33 speaking stops. In the largest organs the 32-ft. Principal Bass is made of wood, seldom of metal. The widest scale Principal pipe of 32 ft., when made of metal, weighs 4½ cwt. (specimen: Hofkirche, Lucerne), and has a diameter of about 18 inches, and a circumference of about 5 ft. According to Töpfer (vol. ii. p. 200), an open 32-ft. Principal pipe requires 1536 cubic inches of wind per second for the C$_{0}$; the c′ requires 99·4, and the c$''''''$ 6·4 cubic inches per second. Open 32-ft. Principal Bass stops of wood (in some churches erroneously labelled Sub-Bass) are of more frequent occurrence. In most cases, the weight of C, in such a giant pipe, is about 8 cwt., with sides of 2½ inches thickness, so as to be able to oppose sufficient resistance to the vibrations of the column of air. The sides of organ pipes are not absolutely motionless; the vibration of the sides can be distinctly felt as soon as the pipe is blown. As the physicist Zamminer, however, says, it is necessary to enclose the air in resisting walls, so that powerful vibrations may be obtained; if they are slack and yielding the motion communicates itself through the sides of the pipe to the surrounding atmosphere, and the vitality of the undulation is annihilated before it reaches the other end of the tube. (*See* Combinations of Stops and Flue Stops.)

Probe Tin. *See* Gamba.

Progressio is a non-repeating stop, more nearly described under the head of Mixture.

Progressio Harmonica. *See* Harmonica.

Prolongement. 1. Combination Prolongement. By means of this pedal, arranged for instance on Walcker's giant organ at Riga, the organist is enabled to keep on the combination of stops already chosen, whilst he prepares any

other set, which can then, at any given moment, be drawn in place of the former set. (2.) Prolongement Harmonique is a contrivance worked by a pedal or stop, which prolongs the sound of the notes struck on the manuals, even after the fingers have left the keys (for instance, during a pause) and are occupied in combining another set of stops (arranged in Cavaillé-Coll's Exhibition organ, 1878). The effect of this prolongement lasts until the pedal or stop releases the keys of the manual.

Q.

Quint is a well-known mutation stop, which has for object the strengthening of the second upper partial. It appears as an open stop with the dimensions of a Principal, and its tubes are cylindrical; but it may also occur cone-shaped, and is then called Gemshorn, Spitzquint, or Nassatquint. The length of the Quint stop is $10\frac{2}{3}$ ft. ($\frac{32}{3}$), $5\frac{1}{3}$ ft., $2\frac{2}{3}$ ft., and $1\frac{1}{3}$ ft., and depends upon the corresponding Principal. The Quint of the 16-ft. Principal is $10\frac{2}{3}$ ft., that of the 8-ft. Principal $5\frac{1}{3}$ ft.; the Quint of the 4-ft. Octave is $2\frac{2}{3}$ ft., and of the 2-ft. Octave $1\frac{1}{3}$-ft. I should here mention the invention of Court Kapellmeister Abt Vogler (died 1814, at Darmstadt), who found, by using the tones discovered by Sorge and named after Tartini (differential tones, the origin of which Helmholtz has explained), that in sounding simultaneously a $10\frac{2}{3}$ Quint and a 16-ft. Principal a 32-ft. tone is produced, and that in sounding simultaneously a $5\frac{1}{3}$-ft. Quint and an 8-ft. Principal a 16-ft. tone is obtained. It is evident that by avoiding an actual construction of the lowest open Basses, 32-ft. and 16-ft., a considerable amount of material is saved (see end of article on Principal). This so-called simplification

system of Abt Vogler's is sometimes employed (for instance, for the acoustical 32-ft. tone in Glarus), and I have often recommended it as a valuable aid (particularly in cases where the height of the church did not permit of any other arrangement). This is the place in which to mention Walcker's interesting combination of the acoustical 32-ft. Grand Bourdon on the Votiv organ at Vienna; this stop is composed of 16-ft. Principal Bass, 8-ft. Octave Bass, and 4-ft. Octave Bass, combined with $10\frac{2}{3}$-ft. Quint Bass and $6\frac{2}{5}$ Great Tierce. Gottschalg says of these five pedal Basses—in reality a 5-rank giant pedal mixture—that, thanks to their construction, they combine to a single tone, which, in point of roundness, distinctness, and power, leaves nothing to be desired. They are mounted on a separate sounding-board, which is very responsive. A covered Quint stop fitted with a chimney is called Rohrquint. (*See* Rohrflöte.) Like the mixtures, Quint belongs only to the Great Organ. (See Octave for the numeric proportions of the simple intervals to their foundation tone.)

Quintaten allows the fifth, that is, the twelfth above the octave, to be very softly heard at the same time as the prime; hence the name of Quintam tenens (see Helmholtz, p. 152), that is, holding the fifth. Quintaten may possibly have been derived from the mediæval Latin *quintadecare*, French *quintadiner* (Allihn). The Quintaten, belonging to the family of the Gedackts, owes this quality to its materially narrow scale. On the upper manuals the Quintaten is of rich, voluminous tone, and when built by a master forms an ornament to any organ. Among organs of modern date, I mention the great Sydney organ, by Hill and Son, in which the 16-ft. Quintaten, placed on the Solo Organ, will be of valuable service. The Madeleine, Paris, possesses a very rare

32-ft. Quintaten on the pedals. Zamminer, p. 265, gives the following technical explanation of this valuable stop:—"An open pipe the size of a Quintaten would be considered a very wide one; as a Cornet stop it is sufficiently slender to allow of the fifth of the octave being distinctly heard if overblown, which is still more facilitated by a low cutting up and stronger wind pressure." (*See* Measurement.)

R.

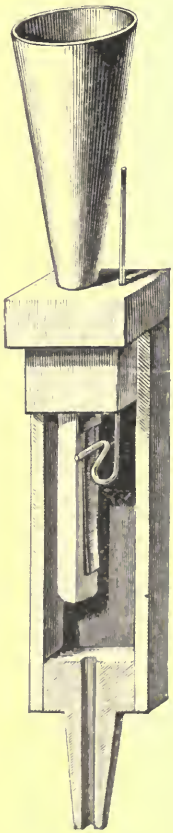
Rauschquint, Rauschflöte. Composed generally of $2\frac{2}{3}$-ft. Quint and 2-ft. Octave; that is, of the fifth and its octave, so that both tones together form a fourth, and have, therefore, a "rustling" sound. I have never found this stop except on large organs. It belongs naturally to the Great Organ.

Reed Stops. Fig. 9. (**Reed pipes, Reed work.**) As this term comprises a whole species of stops, in contradistinction from Flue work, and as it occurs frequently in this book, I think it advisable to give a thorough definition of it, in accordance with technical books on the subject. The current of air, arriving from the sound-board, sets in vibration an elastic tongue (a thin oblong metal plate, Fig. 10, *l*), which periodically intercepts the stream of air (alternately opening and closing). These vibrations of the tongue, or rather the intermittent impulses of the wind,* which at each vibration break through the aperture closed by the tongue, produce

* We therefore have to deal with a current of air passing through the pipe, for which reason Melde ("Acoustics," p. 308) compares these constant condensations and rarefications of the tongue to the periodical changes in density occasioned by the combustion of gas in connection with the air column, tending to vibrations in the so-called chemical harmonica. An exhaustive description of this instrument, so important for experiments on the generation of tone in organ pipes, is found in paragraph 80 of the last-mentioned work.

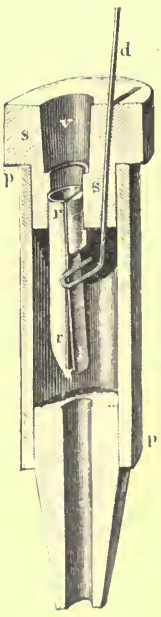
the tone, which, in height or depth, depends upon the length and volume of the vibrating portion of the tongue. How very different the build of flue pipes is from that of reed pipes is evident from the fact that in the latter the visible part of the pipe (resonant tube, as in Fig. 9) contributes in no way to the production of the tone, but only serves musically to refine the sound which originates at the tongue (and to give it the requisite tone colour), and to strengthen it after the mode of a speaking trumpet. The height of these resonant tubes is, however, strictly limited (*see* Trumpet); and Haas, for instance, made a rule that in blowing across the upper edges of the tube (see Tyndall, "Eight Lectures on Sound," p. 212) this cavity should produce a tone half a note higher than the note of the reed for which the tube is intended. If one wishes to investigate, for instance, whether a tube has the right length for c, the hollow of the cup, if blown in the manner above described, must give c♯. As I have said, the pitch of the tone depends upon the length of the excursions of the tongue, which

FIG. 9.



Longitudinal section of a reed pipe, with sounding cup.

FIG. 10.



Reed pipe divested of cup, and side view of the tongue, *l*, set vibrating by the current of air coming from F.

are regulated by the tuning-wire. The scale of the tubes depends upon the pitch produced by the greater or lesser vibrations of the tongue. The lower tones naturally receive larger and longer tubes, the higher tones smaller and shorter ones. The tongue is fastened over a groove or reed, which, when at rest, it closes, with the exception of a very fine chink all round its margin. The tongue is either allowed to vibrate freely in the groove (*see* Physharmonica), in which case it is said to be a free vibrator (*anche libre, frei-schwingend*) (*see also* Vox Humana), or with each vibration it strikes against the edge of the groove, and is then called a striking reed (*aufschlagend*). To soften the frequently harsh tone produced by metal beating against metal, modern art of organ-building has very cleverly resorted to fine leather covering for the edges of the grooves to mellower reed stops.

In Fig. 10, *p p* represents the air chamber, where the groove and tongue are fixed between the wedge and the block *s s*. Figs. 9 and 10 represent longitudinal sections, to allow of an inspection of the cleverly arranged interior parts of this species of pipe.

In consequence of the intense influence which heat and cold exercise upon flue stops, and the difference in pitch from that of the reeds resulting therefrom, these latter frequently require retuning. I will give one example only of the influence of temperature upon sound: the velocity of sound in air at zero, 32° Fahrenheit, is 1090 ft. per second; it increases about two feet per every degree of Celsius—9·5° of Fahr.—as the temperature rises. A cold column of air gives a deeper tone than the same column if warmed and therefore rarefied. For, in spite of the same length of the waves, the tone in warm air is higher than in cold air

because of the quicker succession of these waves. By heat the pitch of flue pipes is, therefore, raised considerably higher than that of reed stops, which is flattened by the extension, and consequent slackening, of the tongue in the same temperature.*

This is a proof that, contrary to general opinion, reed stops with sounding tubes are less subject to the changes of temperature, and their effect upon true pitch, than are flue stops, and that, if there is a difference of pitch between these two species of pipes, it is generally brought about by a change in the flue pipes. The trials made in various organ factories fully bear out this argument. These trials were made with a Trumpet and an Octave, which were first justly tuned to the pitch of the tuning-fork, and were then subjected to artificially produced changes of temperature.

For technical reasons (*see* Flue Pipes) the tuning of the flues should remain the affair of the organ-builder; the organist, therefore, in his attempts to bring his instrument back to the proper pitch, is limited to the retuning of the reeds only. But it is easily understood that even this operation, which is based upon a delicate handling of the tongue by the tuning-wire, should only be performed by conscientious and experienced hands. And though one may always expect conscientiousness in country organists, yet it would not be fair to look for experience. One, therefore, refrains from the use of reed stops in very small provincial organs, and tries to replace them in a measure by the substitution of incisive and string-toned stops (Gamba, Viola,

* The thermal influence on the number of vibrations of a riveted tongue (Physharmonica and Harmonium) may, as experience proves (Zellner), be considered infinitesimally small.

Geigenprincipal). Where the tuning of the reeds can be regularly undertaken by an organist possessing the above-mentioned qualities, one should not, solely on account of expense, omit to provide an Oboe, a Clarionet, a Trumpet, and so forth, according to the size of the organ; but even then only if its construction has been entrusted to a skilled master. With regard to this tuning, I will venture the remark that I do not care to see it done by either simply forcing down the tuning-wire, or pulling it out by a pair of pincers, in which operation the tuning-wire is so often bent, or even broken; rather should this, if at all possible, be done with the aid of a properly constructed reed-knife, which can only move the wire up or down vertically. It is always best at once to replace damaged wires, or such on which the knife has no proper hold for want of a notch,* because the knife might slip off and damage the sides of the pipes.

How important must be a moderate and æsthetically discerning choice of reeds for the flue work, is evident from the fact that no manner of construction is yet known by which it is possible to give to the reeds in the upper registers the strong, piercing tone which, in certain registers, is peculiar to the flues, and by which the latter, in a way, lose their great strength in the lower notes, where in turn the reeds begin to be more decidedly effective. Töpfer ("Orgelbaukunst," p. 104) places this distinctly perceptible relative effect of these two species of pipes upon each other in the tenor octave. The difference in the development of power is most clearly evident; and it is for this reason that the pedals play such an important part in

* *See* Töpfer's "Orgelbaukunst," Diagram CV., Fig. 937, which represents a reed pipe with the upper end of the tuning-wire (not visible in our Fig. 10), and in which this sharp notch may be clearly seen.

compositions for the organ (*see* Marx, "Theory of Composition," Part I., Bk. ii. p. 330). While, for instance, a 32-ft. Principal develops a majestic depth and fullness, the Trombone and Tuba Mirabilis will always have a power and distinctness which, in a way, grates on the ear. The same relation exists between the smaller pipes of each kind.

It is nationally characteristic of the Germans and the French, that whereas the Germans prefer to hear the peaceful tone of a flue pipe in their church, the French incline towards the more lively character of the Trumpet, and it is for this reason that the German organ is distinguished for its glorious flue stops, while the French organ excels in brilliant reeds. I will give two examples of this; for instance, the Münster organ in Ulm (Walcker), as compared to the organ of the Trocadero Palace, Paris (Cavaillé-Coll), and the organ of St. Johanniskirche, Stuttgart (Weigle), as compared to the Münster organ, Geneva (Merklin), without denying that on both sides I heard faultless examples of both species of pipes. Equally admirable and tasteful arrangements are frequently found in England (W. Hill and Son, London), Holland (T. F. Witte, Utrecht) and in the United States, America (Hamilton Roosevelt, New York, and Hook and Hastings, Boston). The Swiss organ-builders also turn out excellent instruments.

I am not sure whether a reason for the more frequent occurrence of the very expensive reeds in English, French, Dutch, and American organs, may not be found in the fact that the organ-builder demands and obtains a proportionately higher price for the sacrifice of time and labour which this kind of pipe entails. I cannot refrain from supporting most warmly the wish of my esteemed friend Gottschalg (*Urania*, Series for 1878, p. 175, and Series for 1887,

pp. 37 and 63), and of the Dutch master S. de Lange (*Leipsic Musik. Wochenblatt,* 13th Series, No. 22), that the conscientious builder, let him belong to whatever nation he may, ought to be recompensed according to his exertions. In this way the careful scrupulousness in executing all the details of new organs would be cultivated and increased. This is frequently the secret of an organ-builder being able to turn out a perfect work of art.

The organ exhibited at Milan with leather-pulp pipes, prepared by a chemical process, leads me to say a word on Italian organ-building, as in nearly every other case the finest organs in Italy (Rome for example) are of foreign origin. In the course of time very different materials have been employed (compare the capital work by Wangemann, 1887, 3rd edition), which has been found to be not without influence on the tone colour of the stops (Prof. von Schafhäutl and Zamminer). The percentage of the influence of material on sound, however, would not be thought of much account at the present time, and when considering the success of modern organ-building. This latter is, for instance, able, by the art of intonation, to make the transition from metal to wood (*see* Æolina) quite imperceptible. This is still more evident if one considers the scientifically proved fact (*see* Flue Stops) that the body of the flue pipe only serves to regulate the vibrating body of air, and to separate it from the outer atmosphere (that is, to limit the quantity of vibrating air). Melde (in his "Acoustics," 1883, p. 242) proposes divers materials for acoustical trials, such as metal, zinc, tin-plate, lead, brass, copper, glass, wood, and pasteboard, and (on p. 24) gives exact tables of the results as to vibrations obtained by small cylindrical pasteboard tubes. Pastor Allihn, who has

revised the new edition of Töpfer's work, writes me word that, if it is intended to form the continuation of the 4-ft. and 8-ft. Octave of wood, he considers the pasteboard material perfectly practicable.

I therefore accepted with much pleasure the kind invitation of Signor Crespi Reghizzo, professor of physics, and inventor of that material, which threatened the organ with a "paper age," to examine personally the organ *a canne di cartone* at Milan. On entering the Oratorio di Santa Cristina the front visible in the background reminded me of the similarly painted English show pipes already mentioned (*see* Principal), only that, in the case of the Italian organ, the grounding was leather-coloured. With the help of a clever Italian organist and of the inventor himself, I was enabled to make myself acquainted with the effects of this innovation, so loudly discussed in the papers. As the instrument was erected by a physicist and an intelligent modellist, named Columbo, without the practical aid of an organ-builder, and as its sole object was to prove the usefulness of a new material for organ-pipes, I will limit myself to making the following mention of the trial. An 8-ft. stop compared with my tuning-fork (870 French vibrations for a′) gave the exact Paris pitch. The general effect of the pasteboard pipes is surprisingly loud and bright, the mixture sound (*ripieno*) is powerful, and the volume of tone on the whole satisfactory. To my ear, somewhat spoilt perhaps, there was wanting the brilliant metallic, and yet rounded, character of the Trumpet, and the decided tone of the powerful English Tuba Mirabilis; and the incisive harmonic string-tone of a slender-scaled, powerfully blown Gamba, supplied with a Frein Harmonique; as well as the enchanting delicacy

of our Lieblich-Gedackts and Æolinas. Without intending to, or being able to, supplant the English tin, or the wood of the fir, oak, pear, and maple, the peculiarity and sound-producing qualities of which Reghizzo by no means undervalues, this new material could still, on account of its unrivalled cheapness, sooner or later assume a certain rank among existing materials, if supported by modern organ-builders. A modest beginning towards a similar combination has already been made in these pasteboard pipes. In reed pipes, for example, the air-chamber, block, and cup are of pasteboard; the groove and wedge, on the other hand, are of wood, and the tongue is a thin strip of brass, thickest where it is screwed on, and tapering into a thin blade towards the lower end. The brass tuning-wire in no way differs from ours. In the Gedackts and Flues all parts are of leather pulp, with the exception of the block (*anima*), which is of hard wood, and the stopper, similar to our Fig. 6. It might be in store for a financial company, with the assistance of scientific and musical professionals, to overcome the imperfections of a first attempt, by procuring the requisite machinery and consulting competent organ-builders, and critically investigating the new invention. It is evident that the most renowned organ-builders of all countries, who are frequently cited as real artists in their profession, will not leave unnoticed such a cheap and easily transportable material; especially if in the long run it should show sufficient resistance to the influence of temperature, and stability with regard to pitch. Experienced friends, whose advice has been valuable to me from the beginning, agree that it was part of the task of this work to mention this new invention of the clever and gifted Signor Crespi Reghizzo.

Still I consider it my duty to remark that, at present, there can be no guarantee for the practicability of employing this material in thoroughly sound new instruments.

My opinion is that, for the present, the best material for an instrument laying claim to a lasting faultlessness is, from beginning to end, English tin (*see* Gamba), combined with the above-mentioned kinds of wood, which by the use of centuries have been tried and proved to be good.

Fig. 11.

Regals is the ancient family name for a number of reed stops, amongst which Geigenregal and Jungfernregal are sometimes used.

Rohrflöte, Flûte à Cheminée (as it is called in France), is a covered flue stop, either of 8-ft. or 4-ft. tone, the lid of which is provided with a chimney (*röhre*, Fig. 11), which lends to the tone a peculiar, rather brighter character. The width of this little tube depends upon its length, both dimensions increasing or decreasing together. The widest must therefore be almost as long as the flue itself (see Töpfer, vol. i. p. 79). The power and brightness of the tone grow as the tube widens, while if the tube be too narrow the tone can scarcely be distinguished from that of a Gedackt. In Silesian organs—for example, on the second manual of the cathedral organ at Breslau—there is a double-lipped Rohrflöte. In small organs the Rohrflöte sometimes takes the place of the Gedackt on an upper manual, if otherwise the flute character be too feebly represented. Both stops may also appear very well side by side. Anyhow, a Rohrflöte should by rights always be secondary to the 8-ft. Bourdon, and should only be employed when the latter

does not occur. (*See* Bourdon.) Rohrflöte, together with a fine, cutting Gamba, Dolce (if arranged on the first manual), or coupled with Viola or Oboe, gives a peculiarly attractive colouring. It combines well with Salicional; for instance, in the organ at Brienz (Berner Oberland). If necessary it may be refreshed by a bright Flûte d'Amour. (*See* Combinations of Stops.)

S.

Salicet. *See* Salicional.

Salicional, Salicet. A much affected stop among the strings, arranged as 8-ft. or 4-ft., rarely as 2-ft., and as 16-ft. stop at Riga. It is, as a rule, of wider scale than the Gamba, and is consequently less cutting in character. The Court organist Gottschalg, of Weimar, writes that in North Germany these dimensions of Gamba and Salicional are often reversed. Seidel and Zamminer derive the word Salicional from the Latin *salicis fistula* (*see* Fistula), English willow-pipe. The articulation of this stop, as well as that of the Gamba, was formerly rather tardy, in accordance with the construction of the pipe. The modern art of organ-building has overcome this difficulty by improved intonation (*see* Gamba). (See Æolina for the use of wood in constructing the lower tones.) If constructed as a pedal stop, it is called 16-ft. Salicet (Nicolaikirche, Leipsic), or simply 16-ft. Salicional (St. George's Hall, Liverpool). In the episcopal church at Lund, Sweden, the Salicional occurs double-lipped (*see* Double Flute), according to Seidel, on the second manual. The 16-ft. Salicional closely resembles the Harmonica Bass constructed in other countries (*q.v.*). A Voix Celeste is often found of charming effect with

Salicional (also Æolina) if tuned slightly sharper than the latter. Salicional is one of the most useful stops for fine combinations. I will only mention for instance Wienerflöte, Gedackt, Flauto Traverso, or Flûte d'Amour, the two latter as refreshers of the 4-ft. tone. (*See* Intonation.)

Sanftflöte. *See* Wienerflöte.

Schalmei. A soft reed stop, usually of 8-ft. tone (for example at the Hague, Holland, arranged by J. F. Witte), and generally labelled Musette in French organs (Madeleine, Paris). Zamminer (p. 228) gives a delightful description of this ancient wind instrument (originally a flat tube of green willow bark blown with the lips). He traces back to this instrument, which was used by the shepherds of the Alps, the origin of the modern Bassoon, Clarionet, Oboe, etc. It appears also as 8-ft. Chalumeau on the third manual of Silbermann's Court organ, Dresden, and as 4-ft. Schalmei on the First Pedal (*see* Hohlflöte) of the Lübeck organ.

Septime (seventh), as I understood from Profs. Fink and Palme, was intended for the Nicolaikirche (Ladegast) at Leipsic. The organ-builders whom I consulted are of different opinion concerning the value and effect of this stop. The organ of Notre Dame, Paris, has three Septimes, one of $4\frac{4}{7}$ ft. on the pedals, and two of $2\frac{2}{7}$ ft. and $1\frac{1}{7}$ ft. respectively on the manuals.

Serpent, 16 ft., and the 8-ft. **Bassethorn**, measured on the same foundation, are smooth, free reed pedal stops, as a rule without a tube, like Physharmonica. They represent the smooth reed-character on the upper pedal of the Ulm Cathedral, and on the Swell pedal of the cathedral organ, Riga. (*See* Ophicleide for its relations to this stop.)

Sesquialtera. A 2-rank mixture stop resembling Sharp, inasmuch as it also has a third, though not in the first

position like that stop, but as fifth and twelfth from the foundation tone; that is to say, on striking the note c′, the notes g′ and e′ are heard. It belongs to the Great Organ.

Sharp is a mixture stop of from three to five ranks, which differs from the mixture proper in that it contains an obbligato third in its first position (for example, Frankfort-on-the-Main, Berne); therefore, if of three ranks, it has c, e, g; if of four ranks c, e, g, c, and if of five ranks g, c, e, g, c. It belongs to the Great Organ, and is found in English organs under the Latin name Acuta, or as Sharp Mixture.

Shut-off Valve is a stop, found for instance on the Münster organ at Berne, which admits and intercepts the passage of wind by means of a valve which works in the wind-trunk. It is also used in conjunction with the slider for combining different groups of stops. It is used by Cavaillé-Coll, Merklin, Ladegast, Steinmeyer, and others. In French organs the manuals as well as the pedals have their Jeux de Fonds (foundation stops) and Jeux de Combinaison (combination stops) on different portions of the wind-chest. Accordingly as the pallet of one or other of the divisions is opened or closed, the combinations of the different groups of stops can be sounded.

Fig. 12.

Sifflöte. *See* Hohlflöte.

Spitzflöte (spire or taper flute) is a much-used open metal stop, with conical tops (Fig. 12). Its tone is somewhat brighter than that of Flûte d'Amour, and it is often used as sharpening stop for several mellow 8-ft. stops on the upper manuals. It appears more frequently as an 8-ft. than as a 4-ft. tone. (*See* Flûte d'Amour for its occasional arrangement on the first manual.)

In combination the 4-ft. Spitzflöte ranges in point of power between 4-ft. Flûte d'Amour and 4-ft. Gemshorn, which stops it sometimes replaces.

Stentorphon. *See* Tuba Mirabilis.

Stop Manuals. *See* Pneumatic Combination Pistons.

Stopped Diapason. *See* Gedackt.

Suabile. *See* Suavial.

Suavial, Suabile. A soft-toned stop like Geigenprincipal, often found on old organs as 8-ft. stop beginning at c′, as for instance in the French Church at Berne.

Sub-Bass (often labelled Bourdon, Grand Bourdon in England). The name of a stop with a 16-ft. or 32-ft. covered pipe. (*See* Gedackt.) In small organs, where the size of the church does not admit of the 16-ft. open pipe, Sub-Bass is quite indispensable (or even side by side with this). We advise the use of Harmonica Bass (*q.v.*) with Sub-Bass, if there is a liberal allowance of pedals, which stop, discreetly giving precision to the sombre fullness of the Sub-Bass, is, in such combination, of special value. In large and small organs Sub-Bass forms one of the most essential stops; and even in the smallest instrument a coupler to the first manual should not be deemed a sufficient substitute. From an acoustic point of view it is worth mentioning that my experience of the character of this stop is that the same note, which may have a tremendous effect in one part of the church, may scarcely be audible a few paces from this spot. This acoustic peculiarity of Sub-Bass (and other tones of lower registers) has therefore caused great trouble to many a builder, and has often made the satisfaction of experts questionable. Prof. Dr. Forster, of Berne, writes to me on this subject: "It would be doing the organ builder a great injustice if one attributed this phenomenon to a

faulty construction of the instrument. In different parts of the church increase and decrease in the tone, especially if this be of great length of undulation and of great intensity, may arise from resonance as well as from interference * of direct and reflected waves.† The appearance or non-appearance of these phenomena is dependent upon the shape and proportions of the interior of the church." The professor had the kindness to prove to me *ad oculos* by physical experiments this explanation, which is as clear as it is concise. Those of my English readers who may take special interest in these remarkable phenomena in the province of physical acoustics are referred to the inimitably clear and unrivalled Lectures on Sound by Tyndall. (*See* Principal Bass for the name Sub-Bass instead of Principal Bass.) Sub-Bass lends itself well to the accompanying of any soft combination. It gains a delicate precision by the aid of Harmonica Bass and Violon Bass. It becomes, however, still more precise with Violoncello. Flute Bass and Octave Bass render Sub-Bass not only more precise, but also thicker and sounder. (*See* Flute.) An admirably delicate reinforcement of the Sub-Bass is obtained by coupling it to a suitable stop on the second or third manual. (*See* Couplers and Combinations of Stops.)

Swell. *See* Crescendo.

Swiss Flute (formerly more frequent in Germany than

* If two or more stones are thrown into still water at different points, two or more systems of rings are formed, which in expanding meet. This meeting—that is, the phenomenon occasioned by it—is called interference. Beyond the point of meeting the waves proceed undisturbedly the same as before.

† If in an enclosed space a sound is produced, the waves of sound progress in all directions, beating against the walls, from which they are then reflected. The angle of reflection is that which is formed by a vertical line erected at the point struck by the ray of sound, and by the reflected ray itself.

in Switzerland) is an 8-ft. stop, which, in spite of its name, belongs rather to the string family, as for example on the Great Organ of the instrument in Magdeburg Cathedral, where it means a loud Gamba. The name Swiss Flute, in the same way as Wienerflöte (*q.v.*), has therefore no foundation whatever.

T.

Temperament (from the Latin *temperare*, to regulate, to proportion) is the manner, described under the head of Octave, of deciding the intervals (laying the bearings), which, in short, enables us to play relatively in tune in all keys (Equal Temperament).

Terpodion (from the Greek τερπω, to delight), according to C. F. Richter, was originally a keyed instrument struck with wooden sticks; according to Schuberth, however, a keyed instrument similar to the pianoforte. This stop is arranged as a pipe with flute-like intonation on the third manual of the great Marien organ at Lübeck, and on the fourth manual of the cathedral organ at Halberstadt.

Tierce. A mutation stop, of Flute tone and Principal size (metal), which, as its name denotes, gives, chiefly in larger organs, the major third e when intonated on c. It is often, like many Quints and Mixtures, mistakenly arranged on small provincial organs; that is to say, without sufficient covering by foundation stops. It occurs as $1\frac{3}{5}$-ft., $3\frac{1}{5}$-ft., and $6\frac{2}{5}$-ft. tone. An uncommon Tierce of $12\frac{4}{5}$-ft. occurs on the pedal of the Nicolai organ, Leipsic. It belongs to the Great Organ.

Tone Colour. This expression for the quality, or as the

French say, the timbre of a stop, has, in the course of this book, been used on almost every page to designate the characteristic difference of the oral effects of the various stops; a further definition may therefore not seem ill-placed. Even if we only compare the Oboe with the Flute, or the Trumpet with the Violoncello, we shall see that, although tuned to the same pitch, they cannot be mistaken for one another, on account of the difference in their Tone Colour. The expression "Tone Colour" has been used by Helmholtz, the greatest authority on acoustics of any age, in his "Sensations of Tone," and has thereby, in the terminology of musical science, become classical. (Compare Melde's "Acoustics," p. 345.) Tyndall owns that the English language has no equivalent, and he therefore envies the German language the suppleness with which it adapts itself to the requirements of nature. It is well known that colour also depends upon the velocity of vibrations, so that, for example, a blue light has the same relation to a red one as a high note has to a low one. Tyndall felicitously compares any one single colour, which has a simple ratio of vibration, with a tone, the vibrations of which cannot be divided into simpler ones (every tone, the vibrations of which have a complicated form, such as a string, must be capable of being divided into a number of simple tones, all of which belong to the harmonic scale [1, 2, 3, 4, 5, 6]. Compare Blaserna's "Theory of Sound," p. 200); while a mixed colour corresponds to a sound, for the production of which the foundation tone and the characteristic harmonics act together. Hence the expression "Tone Colour." In my article on Geigenprincipal, I have made practical use of this theory, by the aid of which Helmholtz explains the violin-like colour of this stop.

Some stops, which strengthen certain high upper partials more than the lower ones, serve to produce specially characteristic Tone Colours, and thereby distinguish themselves from the others. A favourable centre for the foundation of the bulk of the harmony is formed by the sound tone-power of the Principal proper (*q.v.*), which does not bear this name for nothing. The organ has this advantage over all other instruments (says Helmholtz), that the player can mix the Tone Colours in a far higher degree in accordance with his feelings and the character of the piece he is rendering. It is evident how grateful a field for the production of the most varied shades of tone, even with limited means, is open to the skilful organist. He must therefore shun no pains to make himself thoroughly acquainted with the Tone Colour of each stop on his organ; he will find himself plentifully rewarded by the skill in combination which he will soon acquire. (*See also* Combinations of Stops.)

Tremulant. The Tremolo, or trembling, is produced on new organs chiefly by a pallet in the wind-trunk, which, when not in action, presses firmly on the frame of the trunk. When raised by the draw-stop, it vibrates freely in the air-current and offers resistance by means of springs, which assist the vibration. Tremulant is a draw stop used often to vulgarity, to which—being, as Prof. Zellner expresses himself, a "barbarism"—no importance can be attached (*see* Helmholtz, p. 251). The Tremolo can only be applied with effect to the most delicate stops in the Swell (*see*, for example, Vox Humana), and even then only rarely, and with taste and moderation. In the Nydeck organ at Berne, the front side of the wind-trunk, in which the Tremolo works, is of glass, so that its effect may be easily remarked

A new effective Tremolo is (Dienel) now constructed after the manner of blowers (ventilators), which are turned by the current of air like a fan with wings. (*See also* Unda Maris.)

Tromba. Means also Trumpet.

Trombone, Contra Trombone, is a beating reed, intended to imitate the sound of the orchestral trombone, and is seldom missing on large organs. Next to the English Tuba Mirabilis (*q.v.*), it is the most powerful and sonorous of all organ stops, and therefore requires a corresponding number of loud, voluminous stops to prevent it from drowning the others. In medium-sized organs it is often replaced by the softer Bombard. The Trombone occurs oftenest as a 16-ft. stop, and as Double Trombone (Contra Posaune) as 32-ft. stop. (In the magnificent organ now in course of building by W. Hill and Son, for the Town Hall, Sydney, I find the most remarkable feature in the specification to be the 64-ft. Double Trombone on the pedals. This tremendous and peerless reed will, it is confidently believed, have a fine tone and ready speech, but cannot be used except with the Great Organ to good effect. I here mention with pleasure that in England the art of organ-building is of the highest order, and that the oldest and largest English firm, W. Hill and Son, founded 1755, employ at present 140 men in their workshops.) The tubes, usually of wood, are in the shape of inverted four-sided pyramids. By the use of tin for the resonant tubes the tone becomes, perhaps, more brilliant and expressive. The Sydney organ above mentioned has a 32-ft. Double Trombone of metal. (*See* Reed Stops.)

Trumpet, 8 ft., **Tuba,** 16 ft., **Clarino, Tuba, Clarion,** 4 ft., **Clairon,** 4 ft., have all the shape of an inverted cone. Built

and intonated by a master, and supplied with a proper-sized tube, it is a brilliant stop of decided effect. In this stop is shown what the modern art of organ-building can accomplish by careful intonation. One now feels great satisfaction in finding on organs by good makers a Trumpet of a softly rounded and yet lively metallic sound, very different from the hard crashing sound, which in old organs made the Trumpet intolerable. The tone of the organ under its influence loses the dull monotonous character peculiar to combinations of nothing but flue stops. The Clarino (Clairon) is a small Trumpet of 4-ft. tone, found not only on the pedals (along with 8-ft. Trumpet), but also on the manuals. On the Münster organ, Geneva, at Glarus, and in Temple Neuf at Strassburg, I found a 4-ft. Clairon on the Great Manual as well as on the pedals. English organs often possess several Clarions with strikingly brilliant effect. On the pedals of the Stifts organ, Stuttgart, and on the Münster organ, Ulm, there is a Clairon of 2-ft. tone. In the highest octave on the manual this stop repeats (that is, starts again with the larger pipes), because its building would be too difficult up to F'''.

In organs which do not possess any of the modern improvements, it is advisable to exclude the Trumpet from the composition pedals, unless there is a chance of regular tuning of the organ, particularly of the reed stops. If not, the Trumpet, when out of tune (*see* Reed Stops), makes the composition stops as good as useless. By means of these modern contrivances, already mentioned, any one stop may be eliminated from a combination formed by the composition pedal. (*See* Pneumatic Combination Pistons.) If intonated by an experienced hand, the Trumpet requires

no combination to be effective; but I can recommend the melodious, healthy tone of a good Principal as a reinforcement, and the 8-ft. Bourdon with 4-ft. Flûte d'Amour to give it a more tender colouring, or, if necessary, a larger group of flue stops. (*See* Tone Colour, Intonation, and Combinations of Stops.)

Tuba, Contra Tuba, Tromba, Double Trumpet. A trumpet of 16-ft. tone. (*See* Trumpet.)

Tuba Mirabilis. A stop much used in England for concert organs. It is a very powerful, perfectly round, precise, non-crashing 8-ft. Trumpet, or Trombone, generally placed on the Solo manual, which receives a considerably heavier—often more than double—pressure of wind, and is extremely effective. This stop may be opposed singly to the Great Organ. In Roosevelt's organ (115 stops) at Garden City, U.S.A., the wind-pressure of the Solo manual to that of the Great manual is as 10 to $3\frac{1}{2}$. In this organ the Tuba Mirabilis is supported by the powerful and rare stops, 8-ft. Stentorphon and 8-ft. Baritone. In the splendidly restored organ at Westminster Abbey, Messrs. W. Hill and Son in London have mounted an 8-ft. Tuba Mirabilis with heavy wind on a special Tuba sound-board. Walcker has proved by the introduction of his Tuba Mirabilis on the Great manual of his cathedral organ at Riga (124 speaking stops) that German builders also employ this tremendous stop, the mighty power of which is often still more increased by the rarely found Cornettino, a 2-ft. reed-stop.

U.

Unda Maris (wave of the sea). A flute-like metal stop, tuned slightly lower than another (equally soft) stop, with

which, when played, it produces a peculiarly fluctuating (wave-like) tone. (*See* Tremulant on the temperate use of Tremolo stops.) According to Dr. Faisst's opinion on this stop, it would seem that earnest professionals do not approve of the Vox Humana, Voix Céleste, and Tremulant. I agree with the milder opinion of Prof. Zellner, of Vienna, that, according to circumstances, a delicate, moderately vibrating stop may be very characteristic, and in this case has, even from an artistic point of view, a certain claim to recognition.

V.

Vibrations. *See* Octave.

Viola (Viola d'Amore, Viola di Alto). A delicate, string tone metal stop, frequently of 8-ft. and 4-ft. tone, which is often required to represent the Gamba-like character on the upper manuals. It is meant to imitate the tone of the viola (tenor, *bratsche*), and is one of the most lovely solo stops. Bergner, of Riga, has on the first manual of his organ a Viola di Alto of wood, possessing a Gamba-like string tone. In certain registers he prefers this wood stop to a metal one. It combines like Salicional (*q.v.*, and Intonation).

Violin Diapason. *See* Violino.

Violino (Violina, Violin Diapason) is a sharp metal stop resembling Geigenprincipal, and occurs as 4-ft. and 8-ft. tone, for instance, on the instruments of W. Hill and Son, Hook and Hastings, and Roosevelt. (It occurs also in the Church of the Holy Ghost, Magdeburg, as an 8-ft. stop, and as 2-ft. stop on the fourth manual of the Nicolaikirche, Leipsic.)

Violon Dr. Faisst advises that in case the very incisive

8-ft. Violoncello should not suit the quality of the general tone, a wider-sized and rather more powerfully intonated Violoncello, of a clear, sound, and only moderately stringy tone, should be used. He then calls it 8-ft. Violon, in contra-distinction to the proper 8-ft. Violoncello. The name Violon often occurs in Northern Germany for a similar 8-ft. stop, and I have now and again proposed it for Swiss organs.

Violone. *See* Violon Bass.

Violon Bass is a 16-ft. wood pedal stop, after Sub-Bass the most commonly used stop. It is of small scale, and has a pleasantly stringy tone, similar to Double Bass (labelled Violone on the Sydney organ). It combines admirably with 16-ft. Sub-Bass and 8-ft. Flute Bass, and gains decision by the aid of Violoncello. (*See* Harmonica Bass.)

Violoncello, of 8-ft. tone, answers to the 16-ft. Violon Bass, and is a prominently characteristic pedal stop, corresponding in construction, material, and tone colour to the Gamba on the manuals. I have found this stop most satisfactory on all newer organs by good builders, and a characteristic well-articulating Violoncello has been mentioned under "Intonation" as a specimen of the progress made in the art of modern organ-building. (For its combination with Sub-Bass and Violon Bass, *q.v.*)

Voix Céleste (**Celestina**) is an 8-ft. metal stop, slightly higher in pitch than Æolina and Salicional, and oftener employed in combination with these stops than as a solo (arranged as 4-ft. Celestina on the Sydney organ). It has a fine effect (for example, in the Catholic Church, Berne) with the accompaniment of an open Flute (for instance, Flauto Dolce, Flûte d'Amour, etc.), or in combination with Lieblich-Gedackt or Wienerflöte. (*See* also Æolina and Salicional.) It is sometimes labelled, Latin, Vox Cœlestis

(celestial voice). It must not be mistaken for Vox Angelica (angelic voice), which occurs often as a reed, but has been placed by Walcker in the cathedral organ, Riga, as a 4-ft. flue stop.

Vox Angelica. *See* Voix Céleste.

Vox Humana is an 8-ft. metal stop, intended to imitate the human voice, and constructed differently by almost every organ-builder. In spite of the best construction, however, something nasal is always perceptible in the metal tone. According to Helmholtz, the sound in reed pipes is produced by a series of intermittent pulses, which, at each vibration, break through the opening closed by the tongue. (*See* Reed Stops.) Hard, unresponsive material, like that of brass tongues, makes the individual pulses appear more broken than does soft, responsive metal. It is clear that this is the reason why the notes of the human voice, if well trained, excel in mellowness of tone, and thus differ from any of the reeds, even from the best-constructed Vox Humana (*see* Holmholtz, p. 161). The effect of the Vox Humana is improved by local peculiarities, not materially connected with it; for instance, placement in a separate sounding-box, combination with a Lieblich-Gedackt or Bourdonecho in the Swell, tasteful use of the Tremulant. I desist, for evident reasons, from investigating here to which of the last-named acoustical agents this or that Vox Humana may owe its success with the public, and agree in this with Du Hamel (Töpfer's "Orgelbaukunst"), that style of architecture, clever choice of the musical pieces, experience of the organist, and the momentary disposition of the auditor are sometimes much more essential to the success of this stop than the particular construction of the pipe.

W.

Waldflöte is a 2-ft. stop of wide scale, with a strong fluty tone, to be found on large organs (for instance, Riga and Lucerne). In the lower registers it is made of wood, in the higher ones of metal. In the cathedral organ at Magdeburg it is arranged as 4-ft. stop. (*See* Flautino.)

Wienerflöte is one of the most charming wood flutes, intonated rather brighter than Flauto Dolce. As a rule, it occurs on one of the upper manuals as an 8-ft. or 4-ft. solo stop, more particularly in Swiss organs, where it might with equal correctness be called Concert Flute. Under this name I have found it on the third manual of Walcker's organ at Mühlhausen. It may also be called Zartflöte and Sanftflöte; labelled thus, it occurs as 4-ft. and 8-ft. tone in the Nicolaikirche, Leipsic. The denomination "Wienerflöte" lacks all etymological or historical foundation. In the new Votiv organ, although this stands in Vienna itself, there is not a single Wienerflöte amongst sixty-one speaking voices. The competent builder of this organ has, however, placed a Wienerflöte on the third manual of the cathedral organ at Riga, in order to satisfy the increasing demand for a stop of this name. Wienerflöte is one of the most useful stops on the upper manuals, not only as a solo, but also for combination with any other stop. I found it particularly beautiful in combination with Oboe and Flauto Traverso. (*See* Combinations of Stops.)

Z.

Zartflöte. A very delicate and smooth wood flue stop, varying in construction according to the builder. It is generally of 8-ft. tone, appearing only on the upper manuals. Its combinations are the same as those of the Wienerflöte (*q.v.*).

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